AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 11, No. 14. WEEKLY. | NEW YORK, APRIL 7, 1888. | $2.50 per Annum. SINGLE COPIES 5 CENTS.

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A New Heavy Lathe.

We illustrate herewith a new and improved design of heavy engine lathe, which, although massive in size, is made with special conveniences for quick and easy handling. The head stock is webbed its entire length, and is not weakened by cutting to make room for a reverse plate, as no reverse plate is used, all feeds being reversed in the apron. Each lathe is fitted with a simple and substantial taper attachment which is indexed, and can be set for boring a taper of six inches to one foot. The compound rest has a bearing on the cross slide of carriage of 20 inches, and the handles will pass each other without being removed.

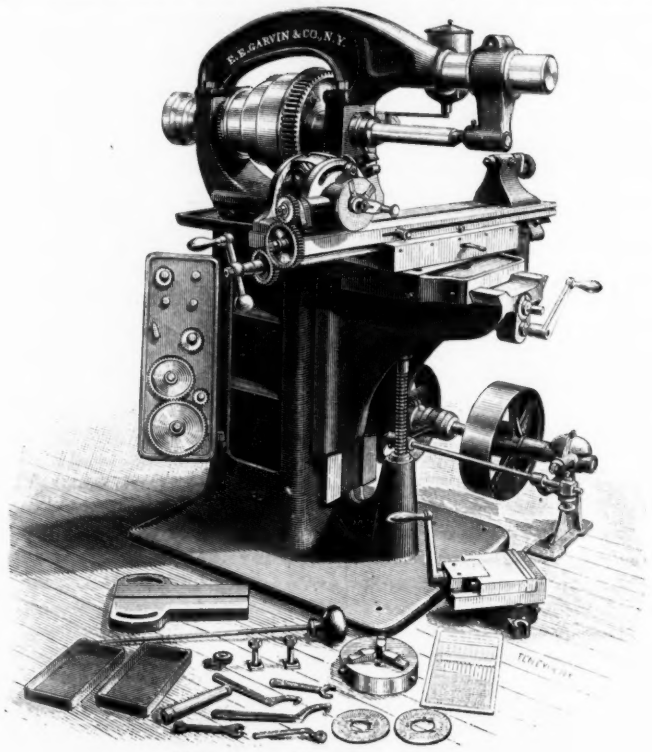
The lead screw is extra large, and is placed directly under the front *V*, on which the tail stock slides. It is inside of the bed, and is covered, taking hold of the carriage in the center of its weight, and directly under the line of strain when cutting screws. The half nuts, which are operated by an entirely new device, are made from solid metal (not babbitted), having planed bearings 10 inches long. The spindles are large, running in long bearings, and can be made hollow if so desired.

The dog shown on the bed may be set and clamped at any point, and will then form an automatic stop for the carriage. This is quite a feature where a large quantity of work of one kind is being done, besides making it very handy to drop the rack pinion out if desired when cutting screws. No worms or worm gears are used, and all feeds will reverse instantly without losing a fraction of a revolution.

The aprons are particularly strong and substantial, can be well lubricated, not at all trappy, and it is claimed will wear a lifetime.

The rest, to turn full swing, is furnished with every lathe. The follow rest is provided with means of adjustment, so that any size shaft within range may be handled without stopping to make collets to suit each and every size wanted. These lathes are also furnished with cabinet legs, which are used as tool-boxes, and which give great solidity to the entire machine.

All attachments described above are furnished with every lathe. They are built the following sizes—17″, 19″, 21″, 24″, 27″, 38″ swing, by Lodge, Davis & Co., Cincinnati, Ohio.



UNIVERSAL MILLING MACHINE.

Englishmen generally view with much doubt as to its success, the American experiment now being tried, of casting large guns in one solid piece of steel; and, in fact, it is held by many who claim knowledge of such matters that the only reliable gun is built up of separate tubes and rings. But it would seem from recent failures of such guns in England, and the comments made upon those failures by writers in the English technical press, that much is yet to be learned of the art of making guns in that way, several of them having failed at the proof test; so we may console ourselves that if, after all, there should be a few failures of our cast guns, we will have no great cause for discouragement, and if finally compelled to abandon the plan we would have to look elsewhere than to the English method for a plan which should be reasonably certain of success.

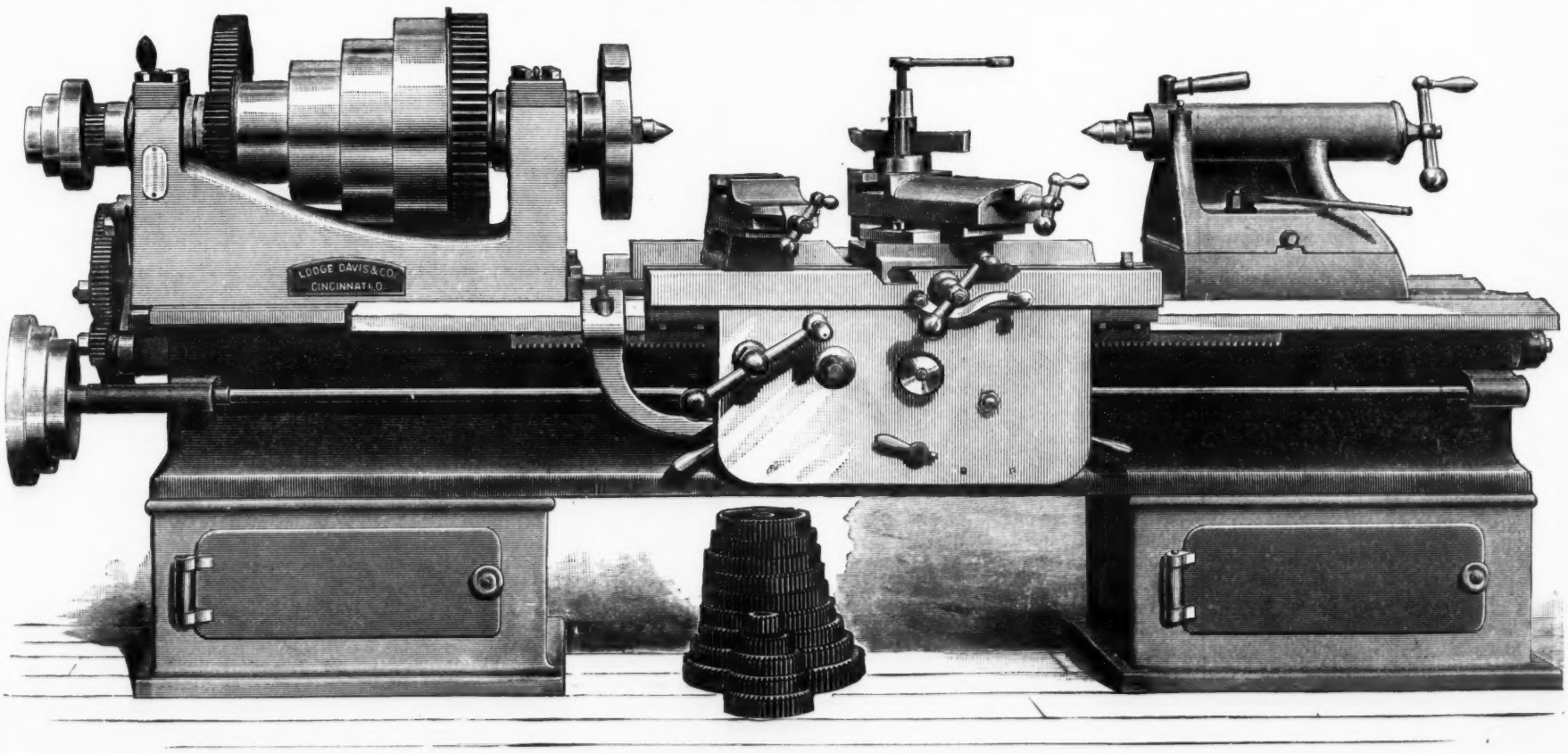
A New Size of Universal Milling Machine.

The accompanying cut illustrates a new size of Universal milling machine recently brought out by E. E. Garvin & Co., of New York city, and by them designated as No. 2. It is a mean between the large and small sizes generally used, and is designed to be stiff enough for doing heavy work with accuracy and speed, and yet small enough to be "handy."

The outer end of the arbor is supported by a center and an extra heavy arm, enabling heavy cuts to be taken far out from the face of the machine. This outboard center is a new application of an old style of center, and consists of a tool steel plug driven into the yoke. A ⅝-inch straight hole in the inner end serves as a bearing for the arbor; it is hardened and ground out to a standard size, and being split through the center, allows for taking up the wear from the top. Provision is made for end thrust, and for the expansion of the arbor by the heat generated in cutting. This style of center has recently been adopted on all sizes of milling machines made by this company.

The dividing head is of the standard style made by this company, and has been fully described in these columns.

The action of the feed is independent of the angle of the table, which ranges to 45° each way. The feed is by a worm and gear, which are made of steel and hardened, and



NEW HEAVY LATHE.

is thrown in and out by the small handle shown projecting through the block. The gears for cutting spirals can be quickly and conveniently set up.

The screws for both the vertical and cross motions are provided with graduated dials reading to thousandths of an inch.

The machine is solidly built throughout, with ample bearing surfaces and means for taking up wear, and with friction countershaft and everything shown in cut weighs 2,500 pounds.

English Boiler Inspection.

By W. H. Booth.

Seventh Paper.

A much debated point in regard to the working of boilers may here with advantage be dealt with, sooner than had been intended, but none too soon, after Mr. Benson's letter in the American Machinist of March 10th.

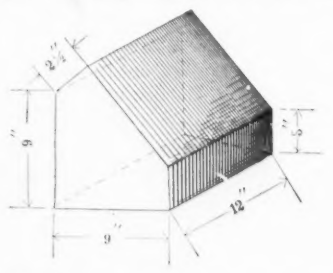
In that letter Mr. Benson refers to the advantages of injecting small quantities of castor oil for the purpose of checking priming. Now, the use of oil, tallow or other greases is an old and deeply-rooted custom; it has for its excuse very good standing, for it will frequently check the evil which it is intended it shall do.

In years past it was no uncommon thing should a pig come to an untimely end for it to be utilized as boiler grease, and piggy would be put through the manhole of the newly cleaned boiler, and left until next cleaning day, when all that was left of him would be removed.

Against grease of all descriptions the boiler insurance companies have had a hard uphill struggle, until now no well-regulated place admits of its use. The condemnation of the practice was due to the repeated occurrence of flue or tube collapses, or in the case of externally-fired boilers of burnt shell plates, for which no cause, as shortness of water, could be alleged. In process of time it was discovered that very frequently grease would form, in combination, with certain of the lime salts so prevalent in most waters, a peculiar deposit of excessive lightness, and, though spongy and honeycombed, utterly impervious to water. Masses of this peculiar insoluble soap, which we have sometimes found several inches in thickness, would collect on the plates, and keeping off all water, the plate would become dangerously overheated and collapse inevitably ensue when the pressure was external to the cylinder, or bulging down of the plates over the fire in rarer cases. Usually the collapse would occur in pockets, small portions of the crown or sides bulging inwards as they softened, and the deposit being perhaps loosened from the plate by its movement, the inrush of water would cool the plate and put a stop to further development of the fault for that occasion, until new deposit was formed. As it is difficult to know when greasy deposit will form, and when it will not, the only safe plan, and the rule universally adopted by all the insurance companies, is to forbid the use of grease, no matter how tempting and convenient it may be. There is a possible exception, and it is claimed that mineral oils do not form any soap with the lime or magnesia salts, and the writer has no record of any such being the case. Suspicion, however, still attaches to the mineral oils, though they, if any, may be possibly exempt from blame. It is remarkable, however, that when mineral oil finds its way into a steam boiler it will make known its presence there by exuding at rivets, which otherwise are perfectly tight. Indeed, mineral oil is most penetrating, and is claimed to loosen scale, whilst causing no danger in the presence of floury deposit, it being that peculiar form of water impurity known as floury deposit, which forms the dreaded grease compound more than any other. Thus it is that grease must be rigidly excluded from a steam boiler.

Another remark in Mr. Benson's letter calls for as much commendation as does grease for the reverse—the blowing out hot of a steam boiler. This should never be done until the brickwork surrounding the boiler be cool also, and though dampness in a boiler flue is the very worst that can happen, it is better in case of an emergency to cool down the brickwork by a jet of water when the boiler is still full than to blow out hot, for the brickwork may be cooled off by water and still remain perfectly dry. But a boiler, if blown out hot, is permanently injured, and especially if much encrusted by scale, may be very seriously strained thereby. When haste is necessary, as may sometimes be the case, it is best to run in a full supply of feed water, so cooling the boiler as it gradually empties; mixing the cold feed say with a half boiler full of the remaining hot water, and so on, reducing the temperature generally. When time is an object and there is a spare boiler, it is always recommended to let the boiler stand full with a partially open damper until the whole has cooled down to the atmospheric temperature.

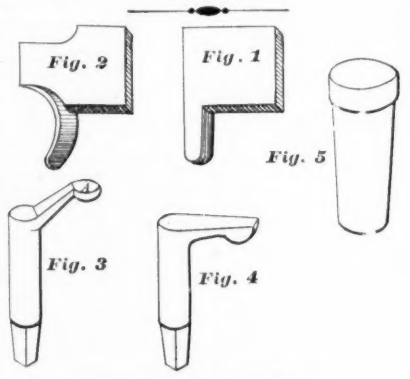
One of the most insidious causes of the destruction of a boiler is corrosion of the plates externally, or in the parts in contact with brick walls and seatings. Years back it was a favorite plan to seat a boiler upon a mid-feather wall, and the draft was thus made to pass along one side of the boiler and return by the other side, the bearing wall being the division between the two flues. These supporting walls were often of considerable thickness; we have found them as much as two feet thick, and as all the weight of a large boiler was thus concentrated along the one line, it was common to find the boiler quite flattened along the line of support, and, by the steam pressure within tending to preserve the circular form of cross section, a constant movement would take place, tending, when corrosive water was used, to set up grooving at ⅛ longitudinal seams, which might occur near the boiler bottom. This, however, was by no means the worst fault of the mid-feather seating. Its chief defect lay in its tendency to corrode the plates of the shell by the accumulation of damp in the bricks in contact with the shell plates. Any water falling upon the boiler, or coming possibly from a leak, would naturally find its way by gravitation to the lowest point, and cause the seating to be damp, and it was no unusual thing to find the plates, thus exposed to the damp seating, to be eaten into holes, and generally wasted, over a very large part of the area of the seating wall. As this became recognized as a fruitful source of danger, it became the practice to narrow the upper edge of the seating until the width in contact with the plates was not above four inches. Even this was dangerous, however, and finally the mid-feather seating was abolished, and in its place was substituted the double seating, in which plan the boiler rests upon two longitudinal supports, separated a distance about one-half the diameter of the boiler. Originally several inches wide, these side seatings have been gradually diminished in breadth, till in the best practice they consist of a row of fire-



brick blocks, as in figure, the seating edge of which is fully nine inches above any flue floor, and not more than 2½ or 3 inches in width. In seatings such as these, formed of hard fire-brick blocks and bearing on a part of the boiler, or considerably above its lowest point, it is difficult for water to effect a permanent lodging, and external covering along the line of seatings has been thus eradicated, excepting in such cases where there is general dampness of the flues from bad marshy ground near by, and perhaps above the level of the seatings. In such a case the whole seating becomes thoroughly soaked by capillarity, and it is important that boilers in such condition and environment be very strictly examined, and even temporarily supported, and the seating blocks thoroughly removed from end to end.

This would more frequently be done were it not that it causes considerable trouble, and is objected to by steam users and not pressed for by the inspecting companies, who fear to lose their clients to other companies, less exacting in their demands.

As to the side seatings, so do the foregoing remarks apply equally well to all points where brickwork is in contact with the plates of the boiler, and there is no point in the care of a steam boiler which demands so much attention as that of perfect dryness in all such localities. Generally it is not desirable that the crown of a steam boiler should be covered in by brickwork. Far preferable are some of the numerous anti-radiating compositions which become soft and discolored in presence of water, and so serve to detect a leak or a bad rivet, which, under a cover of brickwork, might have remained concealed for months until a large surface of plate had been eaten through by corrosion, or even perforation effected or possible rupture brought about.



Details of Blacksmithing.

By B. F. Spalding.

CHANGE OF FORM FOR PROPORTIONING STOCK —A SLIDING TRIMMING DIE—CAST CAST-STEEL VS. CAST-IRON FOR DROP DIES.

It is said that the reduction of iron in the process of rolling is facilitated by changing the shape of its cross section from one simple form to another at each pass; as from square to oval, oval to round, or feathered to square; the object being to leave it, from each groove, in such shape as shall best fit it in passing through the next, to extend greatly in length, and little in width. While, therefore, it is apparently being distorted from the form which it is finally to assume, it is really being modeled in the shape which is calculated to produce that form in the most direct manner. Something analogous to this is met with in forging, where things are to be made in such shapes as make it difficult to block the stock into each part in the proper proportions. In such cases, it is sometimes expedient to block out the piece with the principal object in view, of distributing the stock in the different parts, in approximate proportions, purposely leaving, for the finishing operations, the work of getting it into the required shape.

Gun triggers were formerly made by taking advantage of this method. They were almost universally forged by hand, until 1859–60, but have since been made much easier, with the drop. The finger piece of the trigger is broadened to give a good hold, while the part that goes up through the guard is quite thin. The process of making them formerly was to take a piece of flat iron, turn it edgewise and hammer the end down, on the inside corner of the anvil, and then put it into a stake, set in a sow block, and hammer it into an impression there, which gauged the amount of stock left in the finger piece, and thinned down the back. The stock for the finger piece was all on one side, and, although this did not look much like a trigger (Fig. 1), the stock was there in the right proportions.

The thin part was then put into a slot and two or three blows struck on the finger piece to draw it over into the middle, after which it was put into jumper dies, and these finished it in a very smooth and perfect manner full as nicely as they are now made—Fig. 2. With the drop they are struck a blow edgewise; next a blow on the flat in close dies; after which the superfluous stock is trimmed off in a press, and they are then struck a finishing blow. This is all done at the same heat if the tools are conveniently situated, and the trimming is done hot. They have sometimes been struck the last blow cold after annealing and rattling.

Another illustration of the application of this artifice of getting the stock into a certain form, for the purpose of better proportioning its several parts, is shown in Fig. 3, in which the end *A* is connected to the body by a neck of less than its own cross section. The plan adopted in the forging of these pieces was to take iron, which was already of the right size for the body, and cut it to the proper length. It was then taken to the trip hammer, where the lower end was drawn square and tapering in dies made for the purpose; the exact length from the end to the shoulder being obtained by holding the piece in gauge tongs, the ends of which came against the side of the lower die, and thus determined the place for the shoulder. The pieces then went to the blacksmith, who sunk a fuller into the stock, at the proper distance from the shoulder to make the other end, and blocked out the neck, after which it was put into a die, and the end bent over, and the stock easily formed into the shape shown in Fig. 4. In this shape it was ready to put in a die, under the drop, where it readily assumed the form required. The whole piece was in the bottom die standing upright, as shown in Fig. 3. It was necessary that the square should stand in exact position in relation to the arm, and by this plan it was not possible for it to come otherwise. The fin which formed around the arm was afterwards removed by being trimmed in a "sliding die" under a punch press.

The difficulty in the solution of the problem of trimming these pieces is one which frequently comes up, and is of a general nature. It arose from the fact that, on the one hand, the stroke of the press was only 1½", and on the other hand the height of the piece to be trimmed was about 8". If this piece had been in the form of a round-headed bolt, or of anything that had a small body and big head, it might have been got in by slanting it over until it had dropped low enough to let the head fall under the bottom of the punch. But in a piece of this kind, which held its size all the way, it was discovered that this stroke of strategy would not avail. This piece was of such form that it had to enter the die nearly straight.

Several plans suggested themselves. 1st.—To make the die movable, up and down, in close guides, so that it could be lowered enough to let the forgings be put in, and then raised and locked with some solid packing sufficient to resist the pressure when the fin was punched off. 2d.—To set the die in a fixed position, at a distance far enough beneath the slide or plunger of the press to permit the forging to be put in, and make the punch at the upper end to fit a socket held in the slide in the same manner that broaches are sometimes fitted in broaching machines—close, but easy of removal. The operation of this method would be to drop the forging into the die, and then insert the upper end of the punch into the socket, and then let the punch come down. As nearly the full length of the stroke—say, 1¼ inch—could be used, as the distance from the shank to the punch, this, with the assistance of a broad shoulder, would have been ample provision for keeping the punch in position. The third way, which was the one adopted in this case, as in most respects adapted to the purpose, was to make a bed plate for the punch press, in which a die was arranged to slide in and out. This die struck against a stop when it got home into the right position. It was moved by a horizontal lever, which was worked by the right hand of the operator. Arrangements were made so that when the die was not back into its proper place, the rod running from the treadle of the press to the clutch could not move, because an arm protruded from it which struck on the lever; but when the die was in the right

place, the lever had moved out of the way, the treadle rod could pass it, and therefore the slide could come down, and the punch do its work. This precaution was taken to prevent accidents which might have occurred through the carelessness or negligence of the operator, or from any other cause which might have let the punch come down when the die was in the wrong place. It was proposed to make a separate slide, to which the die should be fastened, and use the tool for general purposes. It was decided that this was not necessary, and made complication. The slide bed was all that was necessary for general use, as was subsequently proved when other things were made which required to be trimmed in this manner. The die for the new piece was easily prepared. The punch was made and fastened in the press slide, and the die planed up and put into its place in the bed plate and up against the stop. The punch was then let down to rest on it, and then scribed around to indicate the bounds of the hole in the die. This had to be cut out as it would out of any die. All the extra work remaining was to drill and tap one hole in it for the screw which formed the fulcrum of its moving lever, and with another small screw, held a sheet-iron apron which prevented the dirt and scales from dropping in and around the slide, and thus kept out unnecessary wear. The other pieces which it was found convenient to trim with this tool were for spindles. They would answer very well to the description of round-headed bolts, except that their heads were quite small in proportion to the size of the body. They were 5″ long; the heads were 2″ in diameter and $\frac{3}{8}$″ thick, while the body was tapering from $1\frac{3}{4}$″ diameter under the head to $1\frac{1}{2}$″ diameter at the point (See Fig. 5). These pieces were made under the drop by being upset from $1\frac{3}{8}$″ round iron. They were not drawn down any on the small end, but were contracted in size by being driven down into the drop die.

Work of this kind is got out of the dies as soon as possible after it fills them, as the rapidity with which it cools around the edges shows that it parts with its heat by communicating it to the surface of the die with which it is brought in close contact. These surfaces expand, while the metal behind them does not. In cooling, subsequently, they shrink, while the metal behind them does not. The necessary consequence is that checks and then cracks come into existence on these surfaces, which, being once started, increase rapidly.

In forging these pieces both steel and cast-iron dies were used, in the form of heading tools, which, guided by three pins, set over a hole of the right depth in the bottom die. The heading tool being $2\frac{1}{2}$″ through, the hole in the bottom die was $2\frac{1}{2}$″ deep, to make up the 5″, which was the length of the spindle. The guiding holes in the tool which set on the pins were recessed in such a manner that by turning the tool one-third of the way around, after the blow was struck, it raised off from the die and lifted the spindle with it, and as this protruded $2\frac{1}{2}$″, it was easily knocked out, and the tool again put back on the die ready for another.

These forgings were also made by dropping them endwise in a die which received their full length. They were ejected from this by a trigger which moved up a steel plug from below in the center of the die. It was found in working these two styles of dies that steel was much preferable to cast-iron in the dies which received the spindle the full depth, while there was so little difference in the wear of the cast-iron and the cast-steel heading tools that the cast-iron was preferred. Heading tools of forged cast-steel were tried, and did not excel those which were cast. If there was any difference, those which were forged checked the worst. The experiment was tried of having a number of tools, and using them in succession, giving them a chance to cool off gradually for the purpose of preventing checking. This was unsuccessful, as they checked as badly then as they did when immersed in water immediately after removing them from the die.

There would be more real respect for the decisions of our highest courts if they would occasionally interpret the laws in the interest of the people.

If the Supreme Court ever gave a decision calculated to break up a monopoly or to check the greed of a great corporation, the fact has escaped our memory.—*The World.*

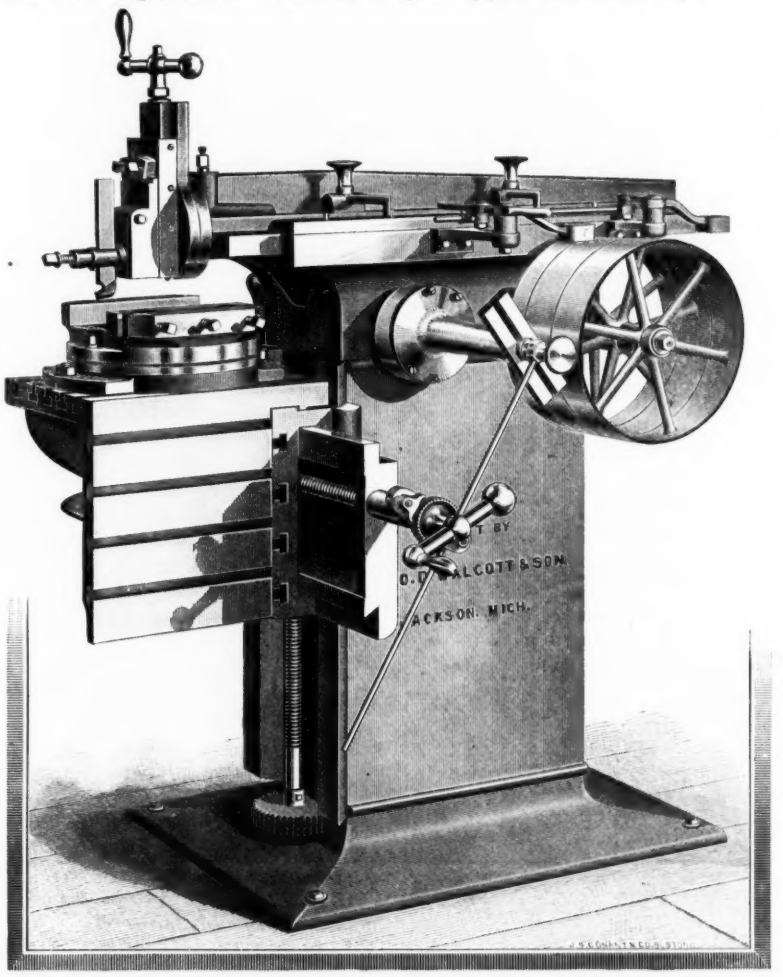
New Shaper.

This machine is designed to meet the demand for a strong, substantial shaper for general work. It is operated by two narrow quick running belts, and is arranged for two cutting speeds for cast-iron or steel. It has quick return movement.

The speed of tool is the same throughout the cut, and the stroke can be changed from one extreme to the other, or to any intermediate point, without stopping the machine.

The ways in which the cutter bar travels extend over the table, giving the bar a good support when at full stroke. The table can be removed and large work may be fastened to sliding platen and planed on its top surface.

It is arranged to cut key ways in long shafts by passing them under the cutter bar. The tool head is graduated, and swivels to



New Shaper.

50° from perpendicular. The gearing is strong, and a heavy cut can be taken with the tool.

These machines are furnished with a graduated swivel chuck, counter-shaft and all necessary wrenches. They are built in three sizes, 15, 24 and 32 inch stroke. Extra attachments are made to go with these machines, such as automatic lever and angular feed in head, attachment for key-seating pulleys, mandrel for circular work, centers and various styles of chucks.

The manufacturers are Geo. D. Walcott & Son, Jackson, Mich,

Shop Notes.

By Jarno.

No. 6.

This morning I again found Gascon in trouble. He has gained something in one direction. Several years ago a correspondent of the American Machinist recommended that, as an instrument for adjusting work to be dressed in any machine tool, the level be taken entirely out of the machine shop. At that time Gascon thought this was straining a point, but he now declares that the correspondent was very nearly right, and that work should be adjusted in the planer, at least, by a surface gauge, or by a square. "Until further notice," Gascon will not have a level or a plumb used about his planers. Should a planer be out of level, it may still do good work if the work is adjusted to the table and not by a plumb.

Still, Gascon is in trouble. He says: "That planer has again defeated me. This time it is warped or winding. In a length of four feet and a width of two feet the table falls .01 inch away from a straight edge. That is, instead of planing in a straight line, the tool cuts along the thread of a long pitch screw. This screw thread would advance twelve miles in one turn of the screw. Starting with the table or platen level, in going three miles the surface called the top would then be plumb; in three more miles the table would be upside down; in twelve miles from the start the table would make the whole turn, and again be right side up."

"What possible use can there be," said I, "in making such calculations? Why do you not fix the planer foundations, instead of spending your time in this way?"

"It is as useful to know the screw thread that my planer will cut, as it is to know the diameter of the earth, or the distance to the moon, or the greatest depth of the ocean—all very interesting and quite useless. I shall have that word 'useful' bolted to your word 'solid,' that you are going to make away with."

"It was only last week, Gascon, that you told me of your discharging a draftsman because you found him calculating the strains, to find how heavy to have the cross-head in a planer you are making."

"It is true; I did discharge him. He had to guess at the 'loads,' and then make his calculations. I wanted him to use his judgment. So long as he had to guess at an important detail he might as well judge of the whole thing. I discharged another draftsman this week because, in giving an angular view of the end of a shaft, he worked several hours to get the position of points in the ellipse that the end of the shaft would show."

"What were you doing, that you did not come round to him before he had put in so much time on his ellipse? I think that planer disease is catching; the planer is not the only thing round here that is warped. You have done the same thing that you would have discharged another man for doing. You could have guessed near enough to the pitch of the planer. It is easy to say that the other man works by guess, or by calculations based upon guesswork, and that we always use our judgment. The difference between guesswork and judgment depends upon whose guesswork and whose judgment we have in mind."

"I made the calculations because I wanted to fix firmly in my mind the fact that the planer had been making a warped surface instead of planing a flat surface. I cannot, just now, spare the planer long enough to have it fixed."

"How did you learn that the planer is warped?"

"Only a short time ago, you will remember, I had the planer leveled, as I supposed. Still, in planing pieces about three feet high, there was some difficulty in getting the sides and ends square with each other, when using the down feed. The higher the work the worse it came. This plainly indicated a twist in the table movement. We could not find this twist with any level that we had. Most levels will lose .002 inch in 10 inches and not know it."

Gascon says that he will tell me how to take the warp out of a planer when I call again, if I do not call too soon.

Reading and Investigating.

It is a very good practice for a mechanic to test the accuracy of rules and kinks presented to him in the columns of his trade papers, and see whether or not they accord with his own experience, and if not, why not. He should not conclude that because a formula or rule, which he may see in print, does not agree with his own experience, it is necessarily wrong, and that the man who formulated or presented it knew nothing of what he was talking about; it may be that the seeming disagreement is caused simply by difference in the conditions, or, as frequently happens, the one who reads is not careful to note exactly what is said, nor to attach to the words used their exact import and significance, so that he fails entirely to catch the real meaning. It sometimes happens that a statement which seems to contradict one's own experience, at first glance, is reconciled by further investigation, and an effort to get at the exact meaning or significance of the words used.

On the other hand, it is a bad practice to take for granted everything seen in print, simply because it is printed. The views of a writer may be entitled to no more respect than your own, especially if he is writing upon a subject with which experience has made you familiar.

Usually, it is to be presumed that one who attempts to write upon a given subject has taken some pains to inform himself upon that subject, and to state his views in exact terms, and it is this fact which, more than any other, perhaps, gives to mechanical writings their value. Not all the things seen in technical or mechanical papers are the result of much care or thought in their preparation, however, and, as remarked at the start, it will pay the mechanic who reads to thoroughly investigate, whenever it is possible. The mental exercise of so doing is of itself beneficial, even if no other good results from it.

A Philadelphia court has decided that Keely must explain his motor and the principle upon which it acts. But we think it is a principle of law that no man can be required to do that which it is impossible for him to do Upon that ground we think Keely will escape the decree of the court.

M. Ferdinand de Lesseps still expresses unbounded faith in the completion and future value of the Panama canal. Notwithstanding the enormous sum of money yet required, he appears to feel sure that it will be forthcoming, and is full of schemes for raising it.

A recent English invention relates to casting packing rings ready for use without boring or turning. The rings are cast in a chill mould around a metallic core.

Practical Drawing.

By J. G. A. Meyer.

FORTY-SEVENTH PAPER.

423. In problem 59 (46th paper) it will be seen that in order to obtain the curves in which the cylinder intersects the lateral faces of the prism, we first find points in the intersections and then join these points by a curve. The principles upon which this construction is based are now to be explained.

In constructions of this kind we employ, or assume cutting planes to be employed. These cutting planes are passed through the solids which intersect each other; and in the problem before us they are passed through the prism and cylinder. Cutting planes should always be passed through the solids or objects in such manner so that the lines in which the cutting plane intersects the solids or objects will be straight lines, and if that is not possible or convenient the cutting planes should be passed through an object so that they will intersect it in a circle, always remembering that a straight line is easier to draw than a circle, and a circle is easier to draw than any other curved line.

Figs. 312, 313. Let $a\ a_2\ c\ c_2$ and $a_2\ b_2\ c_2\ e_2$ be the vertical and horizontal projections of the same prism which is represented in Fig. 309; also let $f\ g\ h\ i$ and $j_2\ k_2\ m_2\ n_2$ be the vertical and horizontal projection of the same cylinder as shown in Fig. 309. Now assume that a cutting plane perpendicular to the horizontal plane of projection be passed through the line $j_2\ k_2$. This cutting plane will be tangent to the cylinder; it is tangent to the cylinder because it does not cut the cylindrical surface, but simply touches it in one element, and this element is represented in Fig. 313 by the line $j_2\ k_2$, and by the line $j\ k$ in Fig. 312. Hence we may say that the cutting plane contains the line ($j\ k$, $j_2\ k_2$). This cutting plane will cut off a part of the prism, and since the lateral faces of the prism are perpendicular to the horizontal plane of projection, and the cutting plane is also perpendicular to the same plane of projection, it follows that the lines in which the cutting plane intersects the lateral faces $a_2\ b_2$ and $b_2\ c_2$ of the prism will be straight lines, and consequently these lines of intersection will be parallel to the lateral edges of the prism. Now, to find these lines of intersection in Fig. 312, we draw through the point a_8 (Fig. 313), in which the line $j_2\ k_2$ pierces the face $a_2\ b_2$, a vertical line cutting the upper base $a\ c$ (Fig. 312) of the prism in the point a_8, and the lower base $a_3\ c_3$ in the point a_9; the straight line $a_8\ a_9$ will be the vertical projection of the line in which the cutting plane intersects the lateral face $a_2\ b_2$. By drawing through the point c_8 (Fig. 313) a vertical line, we obtain, in a similar manner, the line $c_{13}\ c_{14}$, which is the vertical projection of the line in which the cutting plane intersects the lateral face $b_2\ c_2$.

Here then we see that the cutting plane contains the lines $a_8\ a_9$, $c_{13}\ c_{14}$, and also the element $j\ k$, and, consequently, the points 8s and 8t, in which the element $j\ k$ meets the lines $a_8\ a_9$ and $c_{13}\ c_{14}$, are points in the curves in which the cylinder intersects the faces of the prism.

If we now assume that the portion $a_8\ b_2\ c_8$ of the prism in Fig. 313, separated by the cutting plane, has been removed, then the vertical projection of the remaining portion of the prism with the whole of the cylinder will appear, as shown in Fig. 312. The portion of the prism which is section lined indicates that a part of the prism has been removed.

424. Again, Figs. 314, 315. Let $a\ a_2\ c\ c_2$ and $f\ g\ h\ i$ represent the vertical projection of the prism and cylinder; also $a_2\ b_2\ c_2\ e_2$ and $j_2\ k_2\ m_2\ n_2$ the horizontal projection of the same solids.

Assume now that a cutting plane perpendicular to the horizontal plane of projection be passed through the line $q_2\ r_2$, and that all the portions of the prism and cylinder represented by the dotted lines are removed, then the remaining portions represented by full lines in Fig. 315 will appear in the vertical projection, as shown by the full lines in Fig. 314. The end view of these remaining portions of the cylinder and prism is shown in Fig. 316. In the latter figure the line $b_4\ b_5$ represents the edge, which, in Fig. 315, is represented by the point b_2; and the line $b_7\ b_{10}$ represents the cutting plane, which in Fig. 315 is represented by the line $q_2\ r_2$. Consequently the distance between the points b_7 and b_4 (Fig. 316) must be equal to the distance between the line $a_7\ c_7$ and the point b_2.

In Fig. 315 it is seen that the cutting plane represented by the line $q_2\ r_2$ cuts the lateral sides $a_2\ b_2$ and $b_2\ c_2$ in the points a_7 and c_7, and therefore through these points we draw vertical lines, thereby obtaining the lines $a_7\ a_{10}$ and $c_{11}\ c_{16}$, which are the vertical projections of the lines in which the cutting plane intersects the lateral faces of the prism.

The cutting plane also intersects the cylindrical surface in two elements. In Fig. 315 one of these elements is located directly over the other, and consequently both elements are here represented by one line $q_2\ r_2$. These elements are also represented in Fig. 316 by the points s_7, and s_9, in which the line $b_7\ b_{10}$ cuts the circumference of the circle, and the distance between these points gives us the correct vertical distance between the elements. Therefore through the points s_7 and s_9 we draw the horizontal lines $s_7\ q$ and $s_9\ q_3$; the portions of these lines, namely $q\ r$ and $q_3\ r_3$, which lie between the bases of the cylinder, are the vertical projections of the two elements in which the cutting plane intersects the cylindrical surface. But the cutting plane contains, besides these two elements, the lines $a_7\ a_{10}$ and $c_{11}\ c_{16}$, in which it intersects the lateral faces of the prism. Therefore the points 7s and 9s, in which the line $a_7\ a_{10}$ cuts the two elements, must be two points in the curve in which the cylinder intersects the lateral face $a_2\ b_2$ of the prism, and the points 7t and 9t, in which the line $c_{11}\ c_{16}$ intersects the same two elements, must be two points in the curve in which the cylinder cuts the lateral face $b_2\ c_2$ of the prism. In a similar manner can be found any number of points in which the cylinder intersects the prism. By this method the points 2, 6, 7, 8, 9, 10 and 11 in Fig. 309 have been found.

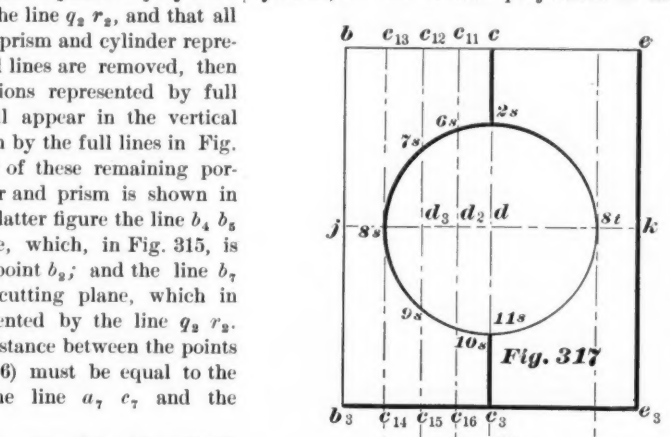


Fig. 317

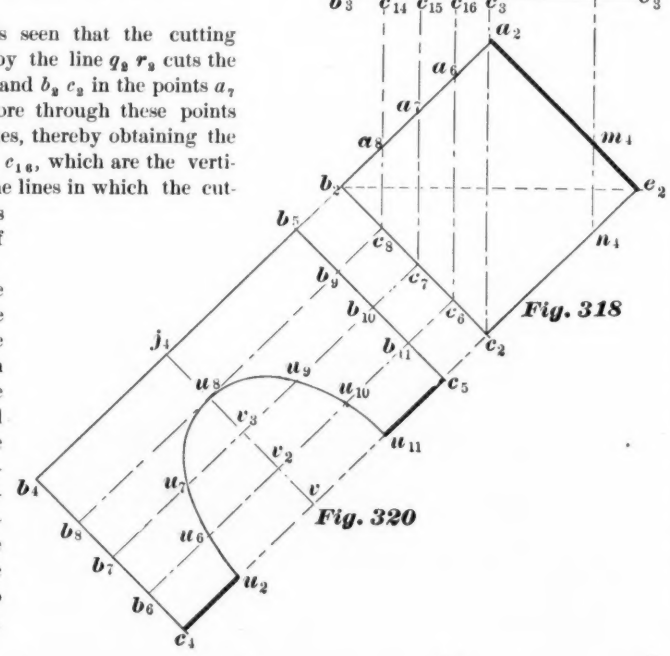


Fig. 318

Fig. 320

Fig. 319

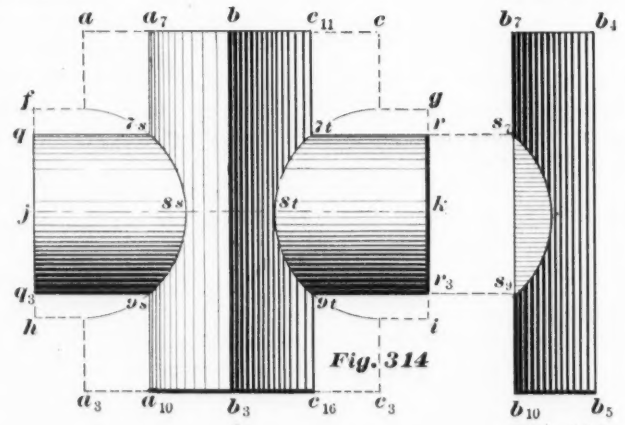


Fig. 314

Fig. 316

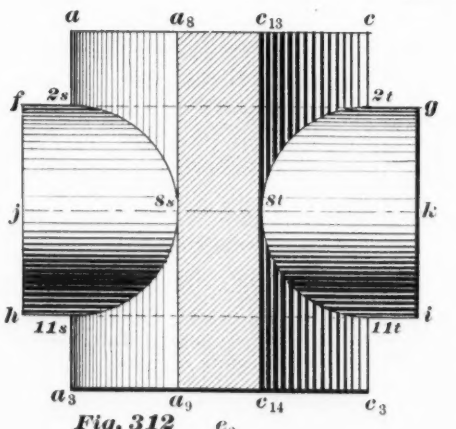


Fig. 312

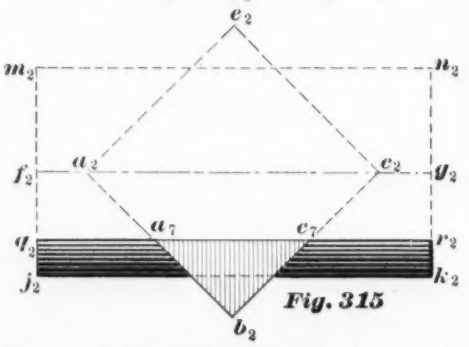


Fig. 315

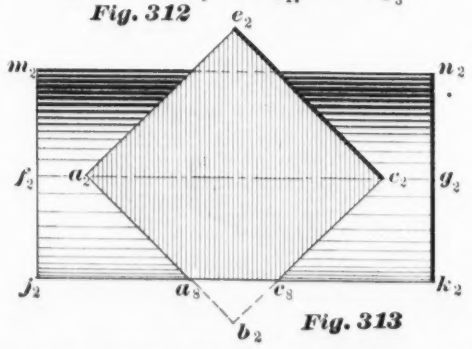


Fig. 313

426.—To develop the surface composed of the lateral faces of the prism shown in figs. 312 and 313.

The curves in Fig. 312 which represent the intersection of the prism and cylinder show correctly the portions of the cylinder which can be seen, and also separate these portions from that portion which is hidden by the prism. But if we consider the prism to be hollow, the curves of intersection, as seen in Fig. 312, do not show the correct form of openings in the lateral faces of the prism made by passing a cylinder through them. Hence, for finding the correct form of opening in the lateral faces of the prism, we have the following construction:

When it is necessary only to find the correct form of openings in the lateral faces of the prism, all that will be required are the two views of the prism, such as shown in Figs. 317 and 318. Let $b\ b_2\ e\ e_2$ (Fig. 317) represent the vertical projection of the prism, and the circle 2s, 8s, 11s, 8t the projection of the hole made in the prism. Also let $a_2\ b_2\ c_2\ e_2$ (Fig. 318) be the horizontal projection of the prism. It is required to find the true form of the openings made in the lateral faces of the prism; or, in other words, it is required to find the development of the surface composed of the lateral faces of the prism.

Through the center d of the circle (Fig. 317) draw the horizontal line $j\ k$, cutting the circumference in the points 8s, 8t. Through the point 8s draw the vertical lines $c_{13}\ c_{14}$ and produce it to cut the horizontal projection of the faces, in the points a_8 and c_8. The distance between the points a_8 and a_2 represents the extent of the opening in the face $b_2\ a_2$, and the distance between the points c_8 and c_2 represents the extent of the opening in the face $b_2\ c_2$. Of course $a_8\ a_2$ and $c_8\ c_2$ will be equal. Hereafter we need to confine our attention only to the face $b_2\ c_2$. Divide the radius 8s d into any number of equal parts, say three, and mark the points of division $d_2\ d_3$. Through these points draw the vertical lines $c_{11}\ c_{16}$ and $c_{12}\ c_{15}$; produce these lines to cut the face $b_2\ c_2$ in the points c_6 and c_7.

From these two views we can now obtain the development shown in Fig. 319. Draw the line $b_5\ b_6$ and on it lay off four equal spaces, $b_5\ c_5$, $c_5\ e_5$, $e_5\ a_5$, and $a_5\ b_6$, each equal to the width $b_2\ c_2$ of one of the lateral faces of the prism. Through the points b_5 and b_6 draw the vertical lines $b_5\ b_4$ and $b_6\ b$. Make the line $b_5\ b_4$ equal to the height $b\ b_2$ of the prism, and through b_4 draw the horizontal line $b_4\ b$, cutting the line $b_6\ b$ in the point b. Through the points $c_5\ e_5$ and a_5 draw vertical lines terminating in the line $b_4\ b$. The rectangle $b_4\ b_5\ b_6\ b$ is the development of the surface composed of the lateral faces of the prism; the lines $c_5\ c_4$, $e_5\ e_4$, $a_5\ a_4$ divide the rectangle into four equal parts, making each equal to one lateral face of the prism. It

now remains to find the form of the opening in these faces.

Draw the line $j_4\ k_4$ parallel to $b_5\ b_8$; the distance between these two lines must be equal to that between $b_3\ c_3$ and $j\ k$ in Fig. 317. On the line $j_4\ k_4$ lay off a point u_8; the distance between the points j_4 and u_8 must be equal to that between b_2 and c_8 in Fig. 318. Divide the distance between the point u_8 and the point v (in which the line $c_5\ c_4$ cuts $j_4\ k_4$) into three equal parts, and mark the points division $v_2\ v_3$. If this construction is accurately made, each one of the spaces, as $u_8\ v_3$, etc., will be equal to one of the spaces, as $c_8\ c_7$, etc., laid off between the points c_8 and c_2 in Fig. 318. Through the points v_2 and v_3 draw the vertical lines $b_6\ b_{11}$ and $b_7\ b_{10}$. From the point v_3 as a center and a radius equal to $d_3\ 7s$, in Fig. 317 ($7s$ being the point in which $c_{12}\ c_{15}$ cuts the circumference), describe two short arcs cutting the line $b_7\ b_{10}$ in the points u_7 and u_9; also from the point v_2 as a center, and with a radius equal to $d_2\ 6s$, describe two short arcs cutting the line $b_6\ b_{11}$ in the points $u_6\ u_{10}$; and lastly, from the point v as a center and a radius equal to $d\ 2s$ describe two short arcs cutting the line $c_4\ c_5$ in the points $u_2\ u_{11}$. Join the points u_2, u_6, u_7, u_8, u_9, u_{10}, u_{11} by a curved line. This curve will be the true form of the opening in the lateral face $b_4\ b_5\ c_4\ c_5$, which is represented in Fig. 318 by the line $b_2\ c_2$. In a similar manner the openings in the other faces can be found.

427. It may be remarked here that the openings in all the other lateral faces of the prism are exactly alike in size and form; and also, when two lateral faces of the prism are placed close together, like the two faces $b_4\ b_5\ c_4\ c_5$, and $c_4\ c_5\ e_4\ e_5$ in Fig. 319, the outline of the openings in these two faces will form an ellipse, in which the line $u_8\ u_{12}$ will be the major axis and the line $u_2\ u_{11}$ the minor axis. But this can only happen when the axis of the cylinder, which is passed through the prism, coincides with one of the diagonals of the base of the prism. (The lines $a_2\ c_2$ and $b_2\ e_2$, in Fig. 318, are diagonals.)

428. This construction for finding the true form of the openings in the lateral faces of the prism is based upon the same principles as given in Arts. 423, 424 in connection with Problem 59. If these principles are understood, there should not be any difficulty in understanding and perceiving at once the correctness of the construction, without giving a lengthy explanation. Hence, we will briefly remark that, in this problem, cutting planes are employed. These cutting planes are perpendicular to both the horizontal and vertical plane of projections. (In Problem 59 the cutting planes are perpendicular to the horizontal, and parallel to the vertical plane of projection). In Fig. 317 the lines $c_{11}\ c_{16}$, $c_{12}\ c_{15}$, and $c_{13}\ c_{14}$ are the lines in which the cutting plane intersects the lateral face $b\ b_3\ c\ c_3$ of the prism. In Fig. 319 the lines $b_6\ b_{11}$, $b_7\ b_{10}$ and $b_8\ b_9$ represent the same lines of intersections of the cutting plane and the lateral face. The reason for placing the lines $b_6\ b_{11}$, $b_7\ b_{10}$ and $b_8\ b_9$ further apart than the lines $c_{11}\ c_{16}$, $c_{12}\ c_{15}$ and $c_{13}\ c_{14}$ in Fig. 317, is, that in the latter figure the distances between these lines are foreshortened, because the face $b\ b_3\ c\ c_3$, which contains these lines, is not parallel to the vertical plane of projection. In Fig. 319 the same face of the prism is parallel to the vertical plane of projection, or we may say it is parallel to the plane of the paper on which the drawing is made, and consequently, the true distances between these lines of intersection can be seen, and must be made equal to the distances between the points c_2, c_6, c_7, c_8 in Fig. 318. Again, because the circle in Fig. 317 shows the exact amount, namely, $2s$ $11s$, $6s$, $10s$, etc., cut out of the lines $c\ c_3$, $c_{11}\ c_{16}$, etc., by passing the cylinder through the prism, the distance between the points $u_2\ u_{11}$, Fig. 319, must be equal to the distance between the points $2s$ and $11s$ in Fig. 317; $u_6\ u_{10}$ equal to $6s$ and $10s$; and $u_7\ u_9$ equal to $7s$, $9s$.

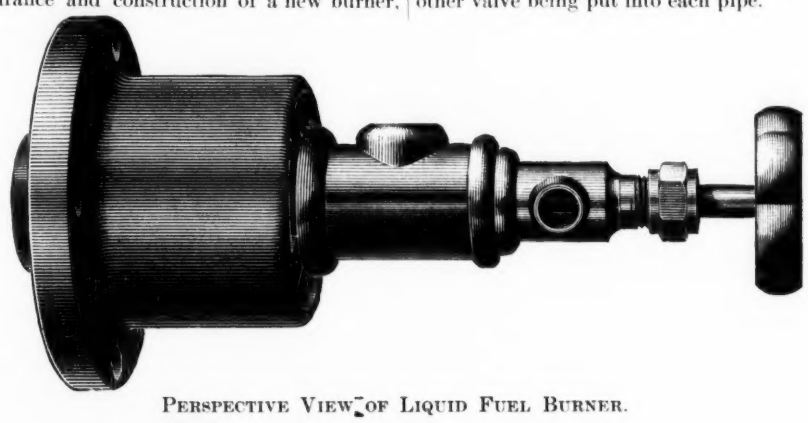
429. Since all the lateral faces and the openings in them are in this problem exactly alike, it will be sufficient for all practical purposes to show only one face with the true form of the opening. This can be accomplished with less labor in the following manner:

Prolong the sides $a_2\ b_2$ and $c_2\ e_2$ to b_4 and c_4, as shown in Figs. 318 and 320. At any convenient distance from the side $b_2\ c_2$, and parallel to it, draw a line $b_5\ c_5$; also draw the line $b_4\ c_4$ parallel to $b_5\ c_5$; the distance between these two lines must be equal to the height of the prism; the rectangle $b_4\ b_5$, $c_4\ c_5$ will be the true outline of one of the lateral faces of the prism. Through the points $c_6\ c_7\ c_8$ (Fig. 318) draw lines parallel to $b_4\ b_5$, and on these lines lay off the points $u_2\ u_6\ u_7$ etc., in a manner precisely similar to that adopted in laying off the points $u_2\ u_6\ u_7$, etc., in Fig. 319. Join these points by a curved line, and thus completing Fig. 320, which shows a lateral face of the prism, and also the true form of the opening in this face.

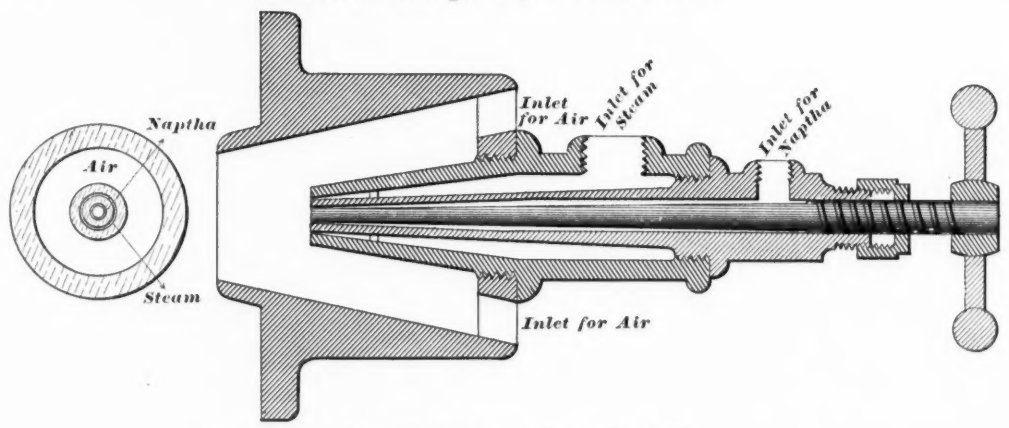
Directions.—In space marked Prob. 60, draw the developed surface, composed of the faces of the prism shown in Fig. 309. Use 3-inch scale.

Burrell's Liquid Fuel Burner.

The cuts on this page show the general appearance and construction of a new burner, or injector, for use with liquid fuel, made by D. H. Burrell & Co., Poughkeepsie, N. Y.



Perspective View of Liquid Fuel Burner.



Section of Liquid Fuel Burner.

Its construction will be readily understood from an inspection of the sectional view, and is such as practical experience has demonstrated to the makers to be the best to serve all the varying conditions under which it may be used.

It is particularly adapted for a furnace fitted up to burn hydrocarbons exclusively, or in any ordinary furnace to burn liquid fuel occasionally.

The burner is in reality an injector, used as an apparatus to concentrate and commingle the vapors and gases resulting from the decomposition of air, water and oil, and the arrangement is such that the proportionate elements of combustion may be steadily controlled and maintained; so that a thorough commingling is effected, and before the united gases reach the heat of the furnace.

The result is that when the united or commingled gases are thus consumed, the combustion of all the parts is perfect, and a maximum effect is obtained.

In construction the "burner" is a combination of three conical nozzles, arranged concentrically together; each nozzle being provided with its necessary inlet, and each inlet being provided with means of regulation. So far this construction would not serve well in practice, as the central nozzle would either be too large or else too small to maintain a regular supply without the use of the central removable and adjustable stem, which is also tapered at the nozzle, and thus serves to regulate to a nicety the flow of oil or naphtha.

This arrangement presents three annular openings to the furnace concentric with each other, as shown in the cut, through which air, steam and oil are injected. In their passage they tend to converge at a point within the furnace, by reason of the conical shape of the inner surfaces of the nozzles, and it is at this converging point that a perfect commingling of the gases is effected and then thoroughly and wholly consumed. The central stem admits of withdrawal for cleaning, this being a feature of the utmost importance.

In attaching this burner to an ordinary furnace, a hole about $1\frac{1}{2}''$ is made through the front, at either or both sides of the door, and above it, so that firing with other fuel will not in any way be interfered with. Into this hole the nozzle of the burner is inserted. The flange on the burner comes in contact with the front, to which it fits snug, and is secured by bolts.

Pipe connections are then made to the boiler and to the liquid fuel tank, a globe or other valve being put into each pipe.

This burner may also be used with compressed air, when steam is not available, and will burn any kind of liquid fuel in combination with it.

The best results attained in burning liquid fuel with this burner, as herein explained, are in combination with other fuel, and it is to this use that it is particularly adapted.

An automatic regulator, of simple arrangement, has been used to control the oil or steam supply, being arranged the same as the ordinary damper attachment, to be operated by the steam pressure.

A correspondent sends us the following. We wonder in how many places it would be possible to find such "engineers?"

"I recently called upon the engineer of one of the largest apartment hotels on the 'Back Bay' in Boston. Said engineer commenced to relate his trouble in keeping up steam compared to the time when his boilers were new. I asked: 'How often do you blow off?' 'Blow off?' inquired he. 'What does that mean? I have been here two years and never had anyone ask me that before, or ever heard of such a thing.' And that engineer is in a building in which live over one hundred people."

English steel makers are busy with orders for shipbuilding material, but slack of orders for steel rails.

Communication on Boiler Inspection.

Editor American Machinist:

A communication on "Boiler Inspection" in a late issue (March 3) of the American Machinist seems to need correction at the hands of boiler inspection and insurance companies, and particularly by the American Steam Boiler Insurance Company, of New York.

On behalf of boiler insurance companies generally, it would have been well for the writer of the article if he had recollected that the interests of agents and the interests of the companies are entirely two different things. It is the interest of the agent to put in as many risks as possible, and have them accepted if he can. It makes no difference to him whether they are good, bad or indifferent. He considers that the lookout of the company; his responsibility ends with the placing of them. But this is just where the company's responsibilities begin. The difference is that agents don't do the inspection and pay the losses, and the companies do. Frequent explosions discredit both the company and the inspector, and an inspector who constantly returned risks as good which proved to be bad, would soon find his services no longer required. If the writer of the article had known that many risks brought in by agents are refused or canceled by the companies, after inspection, he would not have drawn erroneous conclusions from the chance remark of an agent.

The action of the American Steam Boiler Insurance Company is no sort of a mystery to men conversant with boiler insurance business. In the first place the company has *not* doubled its capital stock. What the stockholders did do was to put into the company an amount equal to its capital stock, viz., $500,000, which amount, as the certificate of the insurance commissioner shows, is in its treasury beyond recall. This was made necessary for two reasons:

First. Under the rigid ruling of the insurance department the boiler insurance companies are required to set apart a re-insurance reserve equal to that fixed for fire insurance companies, although the cost of boiler inspections is many times greater than those of the fire companies. Hence, where the policies are for more than one year the expenses and cost of inspection are very much more than the balance of the premium after the legal reserve is set apart. It is therefore necessary for the companies to carry these until the business averages up.

Secondly. The immense business done by the American, and the prospects of greater in the future, led the stockholders to think that the best and business-like way was to put up enough while they were about it, to carry not only the present line but the coming business, big as it might be, with ease and perfect safety.

If the writer of the article will examine the figures with the foregoing lights, he will see that $81,641.95 of the $500,000 paid in is in the Reserve Premium Fund on account of the first reason, and the balance, $418,358.05, is the surplus on account of the second reason, and as an additional security to policy holders. He can rest assured, therefore, that not only that those who insure with the company will be paid, but that they are getting their insurance at the lowest figures, since the company has deferred its profits in the interests of its policy holders, and actually spent more for thorough inspections and necessary expenses, in their interests and their future soundness and success, than the proportion of the premiums belonging to the first years of insurance.

We believe there is no foundation in fact for the charges of interested dealing charged against inspectors in the close of the article. If there is, we have a better suggestion to offer than the writer's. Let every one cognizant of the sale of influence on the part of any inspector report the same to his company, and our word for it, a regard for its welfare will lead that company to promptly get rid of an employe who makes the business it pays him for, subservient to his own interests.

J. F. H.

LETTERS FROM PRACTICAL MEN.

For Milling Machines.

Editor American Machinist:

I fully agree with your correspondent, Mr. W. H. Hoffman, and others who advocate milling as a substitute for planing wherever it can be done to advantage. In your issue of March 24 Mr. Hoffman speaks of changing a planer over into a milling machine and getting better results. Such results I fully believe can in many cases be obtained, but far better ones would ensue were said planer made say five times as heavy and strong. For, in the very nature of the processes, a milling cutter requires much stiffer support than a planing or turning tool, for the reason that the latter is only resisting the pressure due to removing one chip of the width of the tool, while the milling cutter is usually removing several chips at a time, and they perhaps very wide ones.

The ideal milling machine has, I think, yet to be built, but when it comes it will have an enormity of clumsiness which would at this time frighten the average machine tool builder, afraid of his foundry bills, almost into hysterics.

Bridgeton, N. J. Oberlin Smith.

Raising Pulleys to Widen the Face.

Editor American Machinist:

In your issue of March 10 I noticed an article by Mr. Spence, on the raising of pulleys to widen the face. With due respect to Mr. Spence, I think there is a much simpler and cheaper way. I have occasion very often (in fact, too often, as I disapprove of the practice,) to raise the face of pulleys, and the manner of doing it is as follows: After the follow board is down, have square blocks $\frac{1}{2}$ the thickness the pulley is to be raised. After the drag has been rammed up and turned over, lay a straight-edge across the drag and draw the pattern up to it; at the same time draw the hub up. After the parting is made, place the same blocks on the outer end of the arms of the drag pattern, with the blocks flush with the rim of the pattern. Place the upper half of the pattern on, and stick about three $\frac{1}{4}$"-rods between the arms and against the web of upper pattern, also stick a couple of rods down alongside of the arms. This will ensure the pattern against shifting, and will make the arms and rim in line with each other. Of course it requires care in ramming.

In Mr. Spence's plan, after the frame has been screwed fast to the cope, and the pattern drawn its proper distance, there will be 2" of sand that will have no support except that given by nailing, which requires time and nails. In this other way the bars can come down even with the parting, except where the arms come. At best the manner of raising pulleys is very troublesome, and it shows the disadvantage of having pulley patterns in halves, and forcibly demonstrates the advantage of pulley rings and loose arms, as then pulleys can be made any width in less time and with greater security.

F. B. Shaffer.

Boiler Management.

Editor American Machinist:

I find, by observation, that there are engineers and steam users who pay no attention to holding steam over night. Perhaps in no other way will so small an amount of work repay one so abundantly and so quickly. Of course the direct return is fuel saved, while the indirect (and not the least) is the increased life of the boiler by reducing very largely the expansions and contractions. One would suppose that this would be a stale truism, yet the fact remains that a great many stationary boilers are sadly neglected in this respect.

I give an experience for the benefit of whom it may concern. I took charge of an old plant. No damper; furnace doors out of shape and the walls leaking. I put in a good-fitting damper, and refitted the doors so they shut tight. The result was it held steam until midnight. Then I took fire-clay mortar and went over the walls, inside and out, and then could hold steam easily. Have twenty pounds of steam at 6 A. M.; do not bank any fire; and lastly, save 200 pounds of coal daily over the other practice.

Where it is impossible to put in a good damper, owing to shape of breeching, take a piece of sheet-iron and cut it out to fit the front head, so as to cover all the tube ends. It should be stiff enough to stay flush up to each tube. A pair of side braces, swinging from a rivet, may be put in so as to hold the cover in place. By putting in this cover after shutting down, one can easily hold steam.

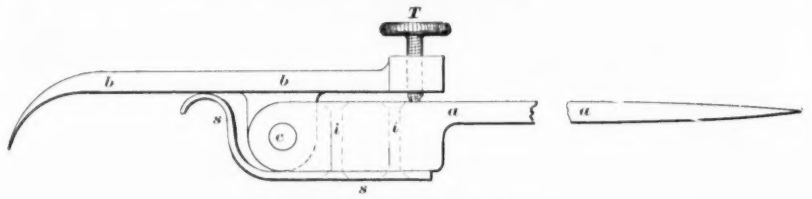
I wonder how many boilers get the fire surface of the shell cleaned except when down for repairs. I saw one bright fellow—now retired—use the hose, but I don't think it did the wall any good. To clean properly nothing is better than a wire brush. There is nothing pretty about the job; nothing that makes your helper desire to wade in and earn glory, and generally he has business somewhere else at that time. Using soft coal and shavings, I find it pays to clean the shell every two weeks. It is also an excellent time to observe this or that seam, rivet or tube, and thus be able to detect any new defect, and one will sleep better, having done their whole duty.

Springfield, Ohio. T. T. Parker.

Needle for Surface Gauge.

Editor American Machinist:

Walking through a machine shop some time ago I saw something new in the way of a needle for surface gauges, a sketch of which I enclose. *a a* is a straight needle held by suitable arrangement in upright of surface gauge; *b b* is the bent end jointed to *a a* by rivet *c*; *s s* spring riveted to *a a*, pressing upwards *b b*; *T* adjusting screw by which the point of *b b* can be raised or lowered accurately and quickly.



Needle for Surface Gauge.

This can be improved upon by making a socket on *b b*—the same as used on compasses for changing from lead to pen—by which a straight needle can be used. In planer work this will be found a much better way of getting down to the thousandth than by knocking.

For case-hardening cast-iron, powdered borax, applied the same as potash on wrought-iron, will give the same results.

Boston, Mass. I. K. M.

Boiler Explosions.

Editor American Machinist:

I have been a constant reader of your valuable paper for four years or more, and have enjoyed exceedingly the articles on boilers and boiler explosions that have appeared from time to time.

Since I wrote you, some time ago, of an investigation I had made, I have been looking into this matter with more interest, and think I have struck two things which possibly and very probably cause not a few of the disasters in the saw and planing mills, viz., poorly fitted water columns and unclean boilers. The latter is almost universal. The majority of saw-mills outside of our cities are either located beside some muddy pond or creek, or take water from cisterns supplied by the roof through eave-troughs. Most of these mills use pumps and heaters fastened to the engine, and run their supply pipe directly into the pond or creek, and of course in this way get a great deal of dirt and mud into the boiler.

Some of the more enterprising mill owners use injectors or inspirators supplied from a barrel, that being supplied by a siphon, the barrel acting as a settling tank for the dirt that would otherwise be fed to the boiler. As the water supply in a great many cases is very scant, especially in dry weather, the boilers are not cleaned as often as they should be by several months.

There is a small mill situated on a railroad running out of this city, that takes its water for the boiler from a sort of pond dug out alongside the track, which is a catch-basin for the ditch that drains the track in wet weather. The water in this pond is, of course, extremely muddy, and the supply pipe to pump is run directly into the pond.

This boiler is insured, however, and is usually cleaned out the day before the inspector is due, which I believe is once in three months. It is almost needless to say that there are already two good-sized patches on the bottom of the boiler. The wages of the engineer, unless he has had an advance, is one dollar a day.

On three of the boilers I have seen, the water columns have been fitted in the following manner: Size of columns, 8 inches long and $1\frac{1}{2}$ inches inside diameter; two gauge-cocks 5 inches apart, $\frac{1}{4}$ inch connections with boiler, the top pipe tapping into the dome, and in no case less than 8 or 9 feet in length, with two or more bends or elbows. The bottom pipes tap into the shell, and are generally placed too low.

In a certain mill I know of they have several factories, including a saw-mill, all under the same roof. I had an opportunity of watching the proceedings in this place for some time, and was not sorry when my time came to go. As the whole establishment was run by the two owners, it kept them very busy attending to so many different branches of the saw-mill business. I ventured to ask one of the busy proprietors who the engineer was. "Oh," said he, "we don't have any regular engineer here. We hire a young fellow to stuff in a few shavings and I run in once in a while to see that everything is all right."

I remarked that the water was very low in the pond, and very muddy, and supposed he was obliged to clean out often.

"Well," said he, "we clean out whenever we have plenty of water, generally, and as it takes two men—one to pump and the other to clean—we generally put it off as long as possible and yet be safe."

I made my way to the boiler room, and there found the young man that "stuffed shavings," and another column fitted with $\frac{1}{4}$-inch connections. The boiler being set three feet from the grates of course brought the gauges and water-glass about ten feet from the ground, and no way of reaching them. I asked him how many gauges of water he carried. "Don't know; we go by the glass," said he. I then asked him how much water he had in the glass. "Don't know, sir; I just fire; the boss he tends to the water." I asked him to see if the water could be seen at the drip cock on lower end of glass. This he tried, but could not turn it with a wrench, and the cock on the column was broken off, so that could not be turned either.

I told him he had better call the boss, and took my departure, with an idea that I had had seen enough of $\frac{1}{4}$-inch water column connections and "shaving stuffers."

I haven't a doubt that this is only one of many mills operated in this same "cheap" way.

The general idea when a boiler bursts is that the water was allowed to become too low; and I think, from what I have seen, that this is the cause of a great many saw-mill boiler explosions, from the fact that the $\frac{1}{4}$-inch pipes become clogged with mud and scale, thereby preventing the glass or the gauge cocks from indicating the exact level of the water in the boiler.

I think the best way is to have as short connections as possible, and have them tapped into the head of boiler, and have a pipe full size of connections with boiler (which should never be less than $\frac{1}{2}$-inch), about 12" or 14" long from bottom of column, with a stop-cock at the lower end. This pipe serves as a settling chamber for the column, and enables it to be blown off without having to climb a ladder to reach it.

It seems to me that this law requiring engineers to have a license in our cities should be enforced throughout the State; and it is surely needed in the country and small towns equally as much as in the cities, as the majority of these explosions occur in small towns, or in the country in some out-of-the-way place. "Something for nothing" is the motto of a great many mill owners, and in practicing this they cause, directly or indirectly, a great many of these boiler explosions, which oftentimes entail great loss of life and property. Engineer.

Hardening Cast-Iron.

Editor American Machinist:

In answer to Mr. Torrey's letter in your issue of March 17th, I will say that in hardening cast-iron we proceed as follows: Heat the piece to be hardened to a very bright red; apply potash; reheat the piece if necessary, and dip it into the water. The potash ought to be pulverized, so as to melt easily. Care will also have to be taken in reheating the piece, as the potash is likely to burn off and thus leave the iron soft.

Since reading Mr. Torrey's letter I have made a few experiments with different grades of cast-iron. I selected a piece of old stove plate, which, upon examination, proved to be as soft a piece of cast-iron as I ever saw. Hardening this piece in the above-described manner, and testing it with a file, proved it to be hard clear through; annealing the piece made it as soft as before. I then took another piece of the same kind of iron, heated it to a dark red, and hardened it as before. When testing it with a file it proved to be only middling hard, that is to say, the file would touch it a little.

As far as my experience goes, whenever I have heated a piece of cast-iron to a dark red it would never prove to be hard enough, thus proving to me the fact that it takes a very bright red heat for hardening cast-iron.

I had four cast-iron bars made; the thickness of two of them was $\frac{3}{4}'' \times \frac{1}{2}''$, and of the others $1\frac{3}{8}'' \times \frac{7}{8}''$. All the bars were harder than the stove plate, but could be easily filed. Hardening the $\frac{3}{4}'' \times \frac{1}{2}''$ bar I obtained the same result; it would harden clear through. Hardening the $1\frac{3}{8}'' \times \frac{7}{8}''$ bar would make the outside hard, but upon breaking it the center portion proved to be softer than the outside. This bar also showed, after hardening, a coarser grain in the center than towards the outside, undoubtedly caused by the outer portion cooling faster than the center, thus opening the grain. The piece of stove plate and the $\frac{3}{4}'' \times \frac{1}{2}''$ bar would, upon breaking, show the same grain clear through.

The grain of the cast-iron, after hardening, will be somewhat finer than before, but will, as far as my experience goes, not have the appearance of chilled iron.

As to its wearing capacity I have no experience. The rollers spoken of in my first letter are used for glass-blowers' swivels, and are working on cast-steel pins. Some of these rollers would come back with the pin worn off, but the roller showing very little wear.

I do not doubt that the quality of the iron is impaired by the hardening process, as it took only a very light blow with the hammer to break off a piece one inch long, while before hardening I had to strike several heavy blows to break a like piece. I had no means at hand to determine how much the quality of the iron will be impaired.

Louis Kunz.

Air Pump Difficulty.

Editor American Machinist:

The article by C. A. G., "An Air-Pump Difficulty," in your issue of March 3, attracted my attention, and I have been looking for an explanation, if one is possible. But although I cannot attempt to explain it myself, I would call attention to what seems to be some errors in C. A. G.'s conclusions, which have so far escaped notice.

"The fact of the air-pump holding a piece of rubber packing tightly over the inlet opening while the pump is running at any ordinary speed," is no proof that the inlet valves are tight. For the inlet chamber of pump connecting with both valves, what leak takes place under one valve goes to supply air for the other end (for the pump is double acting), and the chamber being so large—nearly 2″ diameter and the length of the cylinder, besides a cross connection in the lower head—admits of a rarefaction of air in it which will amply make up in the time necessary to restore equilibrium and also slight leakage under the packing, and also of the valve at the discharge end, during the time the piston is reversing its motion and making the part of stroke necessary to restore the vacuum in the chamber.

Again, C. A. G. says, with evident surprise, "Still the pump kept going, just as if it was getting all the air it could draw." I have made several tests to learn, if possible, the action of an air-pump where the air inlet was tightly closed, and also when it was only choked, and I have uniformly found the pump to gain in speed after the first few strokes, and to run faster when the inlet was closed tight than when only choked. This I reason out to myself thus: If the piston can draw no air, it has, of course, none to compress, and after the pump has run long enough to exhaust the inlet chamber, its piston must be working in a partial vacuum during a portion of the stroke, and consequently requires less power to move it, as it is doing no work. In the case of slight leakage, the pump only has to compress what air it does get to the discharge pressure, and to force the small quantity through the contracted area of the discharge valve, instead of the much larger quantity it would be handling if it had free admission. Of course the effective pressure the pump would be working under is increased by the amount of the vacuum on one side of piston, however much that may be. Quite likely the hammer action of the pistons, which was discussed in the American Machinist some three years ago, has an influence in this case tending to help over the extra resistance offered by the vacuum.

I have used nearly the same plan as described by C. A. G. for testing valves, that is, as far as his way is described, and with good results, the only differences being in minor details. I run the pump carefully, with lower head removed, to test tightness of piston. In one case of a heavy pound on the lower head, I found the reversing valve stem and reversing plate in top of steam piston worn so much as to increase the travel of piston. A slight upsetting of reversing valve stem cured the difficulty until general repairs could be made.

Chas. S. Beach.

Bennington, Vt.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

By W. H. Hoffman.

Second Paper.

There is a wide range in the diameter of marine engine crank shafts. We have the 85 foot yacht with a 4½ inch shaft, and the 520 foot steamship with a 21 inch built-up steel crank shaft, and the work in both lines of service is always exacting. Though we build our foundations as well as modern ship architecture will permit, yet the elements of construction necessary for a smooth running shaft are in a large measure lacking, on account of the nature of the structure to which we must fasten our machinery. We must, therefore, proportion our crank shaft to suit these arbitrary conditions, and the strength, weight, and area of journal surfaces must be equal to the emergencies always liable to present themselves.

There are various opinions among marine engineers as to the safe working pressure per square inch on the journals of the main crank shaft. Some designers reduce this pressure to 300 pounds, while others raise it to 700 pounds; but the writer thinks that 600 pounds should be the ultimate pressure, and knows that 400 pounds gives the best results in the long run. In adopting a moderate pressure we may sometimes be obliged to increase the diameter of the shaft a little, in order to avoid a long and troublesome journal; but this can be easily accomplished. Under no circumstances must we make the journal too long on a marine engine, for by so doing we are sure to have an increase of friction and hot boxes. These troubles will be principally due to the spring of the ship's frames, engine keelsons and bed plates.

Triple expansion engines are made with four and six main crank shaft journals, according to the nature of the design. The tri-cylinder three-throw, or 120° system, is now usually made by coupling together three single cranks, all being alike and so fitted that any one of them can be placed under either cylinder; and this is probably the best arrangement, all things being considered. With the coupled cranks just described, it is the common practice to make six short journals, instead of the four long ones formerly used; and this brings us to the question of the proper length of each journal where six are used. The sectional plan will give us a shaft smaller than the old style, when it was forged in one piece, for the reason that we know the sectional forgings to be sound (the center of them being bored), while with the old method of forgings we were compelled to increase the size of the shaft to allow for the unsound center.

The boring of a crank shaft shows at once the condition of the central section of metal, removes a portion of the weight that is useless for work, and provides, on small shafts, excellent means for automatic lubrication.

In making a crank shaft sectional, we have a comparatively small forging, the space occupied by it being reduced to such an extent that it is quite convenient to carry at least one, if not two, spare sections in the engine store-room. If there are no spare sections on board, and there should be a breakage of the after crank shaft, the forward section can be removed and placed in the bearings of the after section, and the forward cylinder cut off from the others. In making such a change the two remaining sections must be set either at 90° or 180°. Thus it will be seen that the triple expansion system has many advantages over any other method for any service, and when I say this I include large mill engines from 500 to 3,500 horse-power. The modern triple or quadruple expansion engine can be and has been so designed and constructed, that any combination of cylinders can be obtained by simply arranging the pipes and receiver connections to suit the requirements.

One of the best English yachts has six steam cylinders, and three cranks placed at an angle of 120°. The engines can be run as three two-cylinder tandem compounds, or as a triple expansion engine, or as a quadruple expansion engine, and the changes can be made in a few minutes.

There has been so much misinformation circulated about the modern high steam, high grade expansion steam engine, that it is quite a task to lay down a course for a thorough explanation of this very simple machine. When quite young in the business, I was told by a former engineer-in-chief of the U. S. navy that the ideal steam engine would be one running with an initial pressure of 150 pounds, expanding fifteen times, and so well protected from loss of heat, that the engine room would be uncomfortably cool in cold weather. And, in conclusion, he said: "Never forget, young man, that the steam engine is simply a heat engine;" and I have always remembered his remarks.

The moment we light the fires our troubles begin. We are losing heat all the way from the top of the ash pit to the condenser, and the best steam engine is the one that gives us the most energy with the remaining heat.

It has long been known that in theory a high steam pressure and an early cut-off would give very economic results, but these results were never realized in practice until the modern compound or high grade expansion engine was introduced. In future papers I shall endeavor to explain the reasons for these results.

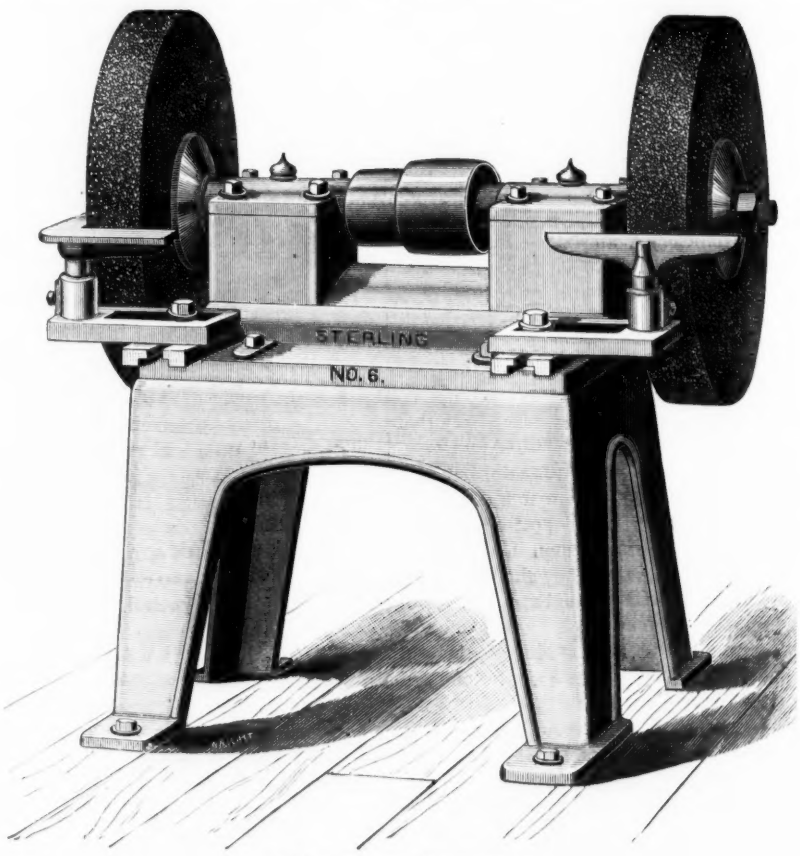
The writer believes that many of the published accounts of the trials of large compound marine engines have been, in a measure, misleading and incomplete, inasmuch as the evaporative duties of the boilers have not in all cases been closely determined, so that the student or others in search of information regarding the comparative merits of simple and compound engines, often meet with conflicting data that has a tendency to shake their faith in our modern multi-cylinder steam engines.

The economic duty of a marine steam engine consists in the propulsion of a certain midship section and tonnage at a certain speed with the least amount of fuel. So the problem starts at the grate bar, and ends at the leaving edge of the propeller blade.

Returning to the consideration of the crank shaft, take, for example, a triple expansion engine, with cylinders as follows: High pressure cylinder 26″ diameter, intermediate cylinder 40″ diameter, and low pressure cylinder 68″ diameter, with a common stroke of 54″. This engine would be suitable for a ship of 3,000 tons, and would develop 3,300 horse-power, its regular work, and 3,500 if necessary; revolutions, 80 per minute. Actual practice shows us that with the strokes and pressures now in general use, $\frac{22}{100}$ of the diameter of the low pressure cylinder is ample for the diameter of the crank shaft journals when hammered steel is used, and $\frac{27}{100}$ when iron is the metal. If the shafts are of built-up steel they can be reduced to $\frac{18}{100}$.

If our cylinders are 26″—40″—68″×54″ with a piston speed of 720 feet per minute, then our built-up steel shafts should be 12⅜″ diameter in the journals, and this allows $\frac{5}{14}$ of an inch for re-turning the journals when necessary. The total initial pressure on the high pressure piston would be 84,800 pounds, or 42,400 on each journal. At 400 pounds per square inch, this would call for 106 square inches on each journal, and as we have fixed our shaft diameter at 12⅜″ it will be seen that in *theory* we have a large margin. Mechanical difficulties, however, such as errors in fitting, springing of the structure, etc., prevent us from making all the surface available, so that in *practice* we must not calculate on having more than 70 per cent. of the surface for actual work. We will then fix the length of our journal at 12″, and this will be safe from heating. Thus we will have for this engine six crank shaft journals, each 12⅜″ diam.×12″ long, presenting a total length of 72″. These will give better results than four journals, each 18″ long, as they can be kept true through their whole length, while the latter cannot.

The vessel described would be 350 feet long over all, 40 feet beam, and 27 feet depth; the speed would be from 15 to 16 knots per hour.



New Emery Grinder.

New Emery Grinder.

The machine which we illustrate herewith is built with a view to furnish a substantial machine for emery grinding. The machine is not only heavy, but the effort has been to so distribute the metal as to best resist the strains and do away with all vibrations. The legs have sufficient slant to insure stability, and with their unusual strength provide for great rigidity under heavy work.

Following are some of the principal dimensions: Floor space, 31×27 in.; bench space, 27×17 in.; length of spindle, 38 in.; diameter of spindle in bearings, 1¾ in.; diameter of spindle between flanges, 1¾ in.; distance between wheels, 28½ in.; length of bearings, 8 in.; diameter of flanges, 7 in.; weight, including countershaft, 750 lbs.; height, floor to center of spindle, 33 in.; size of cone on spindle, 6 and 4½×4¼ in.; size of cone on countershaft, 14 and 15½×4¼ in.; size of T. & L. pulleys on countershaft, 8×4½ in.

The manufacturers are Sterling Emery Wheel Co., 22 Warren street, New York.

An item is going the rounds, which purports to relate how the auger was discovered. According to this it would appear that in 1680 an Englishman saw some boys trying to make a hole in the ground with a piece of iron barrel hoop; after the barrel hoop had penetrated some distance it became twisted and then carried the dirt up to the surface nicely; noticing this, he invented the auger. This sounds very well until you happen to think that when the boys used that barrel hoop it undoubtedly twisted the wrong way, and, instead of raising the dirt to the surface, had a tendency the other way.

The Council of the Iron and Steel Institute has received a number of letters from prominent members of the American iron and steel industries, in which is urged the desirability of postponing the meeting of the Institute in the United States for another year, as during the whole of next autumn the American people will be very fully occupied with the presidential election. The council has therefore decided that the autumn meeting of the institute should not be held in the United States this year, and will shortly make an announcement of the locality selected instead —*Engineering* (London).

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co.
96 Fulton Street, New York.

Horace B. Mibler, Pres't and Bus. Manager.
Lycurgus B. Moore, Treas. and Sec'y.

F. F. Hemenway, Editor and Mech. Engineer.
J. G. A. Meyer, } Associates.
Fred J. Miller, }

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$2.50 a year in advance, postage prepaid in the United States, Canada and Mexico.
$3.50 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 Bouverie Street, Fleet Street, London, Eng., will receive subscriptions for the American Machinist, at 14/7 per annum, postage paid.

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The Albany News Company, Albany, N. Y.
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NEW YORK, APRIL 7, 1888.

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Health and Efficiency.

Nearly all manufacturers recognize the fact that in order to get economical results from the use of steam power something more than the mere selection of good and efficient engines and boilers is necessary. They know that after the purchase of such machinery comes the necessity for securing such conditions as will allow of the best attainable efficiency in its use.

There are not many manufacturers who would invest in first-class and expensive machinery of that kind and then give it such conditions as would effectually prevent economical results being obtained; the intelligence and discrimination necessary to such selection being usually accompanied by the intelligence and discrimination necessary to perceive the importance of proper conditions for its economical employment.

The mannfacturer who should provide for the furnace of his steam plant, fuel of a quality utterly unsuited to it, admit under its grates carbonic acid gas instead of air, supply the boilers with impure water to corrode and ruin them, or who should voluntarily allow his engine to run in a dust-laden atmosphere with its journals supplied with stuff calculated to destroy them instead of lubricate them, would be considered very short-sighted and foolish, and there are few men managing shops who are not possessed of sufficient intelligence to avoid such a combination of conditions, or, in fact, any one of them.

But there are many shop owners and managers who fully recognize this, and yet entirely fail to recognize a fact which should be equally plain, that is, that workmen, in order to attain the best possible efficiency, must be given the conditions necessary to secure that efficiency, and since that part of these conditions which relate to the health of the workman are imposed by nature, it is folly to disregard or attempt to evade them.

Mechanics and workmen are, in a certain sense, engines, whose energies are directed towards a certain end, for the accomplishment of which it is not only necessary that they should of themselves be fitted and competent for the work they are to do, but that they should be surrounded with all the conditions necessary to the best possible employment of their skill and energy.

It is not enough that they should be supplied with first-class tools and appliances, but also that there should be an abundance of fresh, pure air, and light. Not only is light necessary in order that men may be enabled to see to do the work which they have to do, but it is necessary for health. Nature having designed mankind to live in the light of the sun, and to breathe pure air as supplied by her, it is important to proprietors, as well as to workmen, that use should be made of them as nature intends, and a failure to do so will inevitably result in more or less injury to health, and consequent decrease in efficiency.

The most efficient man, other things being equal, in either mental or physical labor, is the man who has the best health, whose lung power is greatest, and who secures for his lungs the proper amount of nature's lung fuel, oxygen.

We believe that the vast importance, from an economic as well as from a moral point of view, of securing for shop men the proper sanitary conditions is very imperfectly recognized by many, if not a majority of shop owners, and that a study of this question would result in decided benefits, both to employers and employes, in very many cases.

Some of the Lessons of the Storm.

The recent storm, by which New York city was cut off from intercourse with the rest of the world, afforded a striking reminder of the intimate connection between labor and subsistence, and should be a valuable object lesson for those who are disposed to despise labor and deify mere wealth. A practical demonstration was afforded of the fact that the man who possesses millions in the form of bonds, mortgages, notes, etc., is only better off than his poorer neighbor to the extent that he may be able to secure actual and real values represented by them, and that if, for any reason, labor is rendered impossible or its immediate products unavailable, he is as helpless as the poorest; perhaps more so. The condition brought about by the storm need only have lasted a few days longer to have carried the illustration to completion.

An instance of the practical working of the law of supply and demand under peculiar circumstances was also presented. Dealers in coal, milk and other necessaries, seeing that no supplies could be obtained for some days at least, immediately advanced prices to fabulous figures, notwithstanding the fact that in most instances that which they sold at such prices had cost them no more than ordinary. This had the effect to deprive many worthy people of accustomed fuel and food, and transfer their supplies to those who were more fortunate as to the possession of wealth without regard to worthiness; thus seeming to contradict the law of the survival of the fittest—a law which is frequently disproved by conditions brought about by the progress of modern civilization.

The present status of workmen in our great industrial establishments is not, unfortunately, such as to force them into the way of independent thought and action to the same extent as was formerly the case. But if there is not quite so much of the incentive of necessity as there formerly was, there is nothing to hinder thought. The man who thinks and studies about his work, although he may not feel himself strictly called upon to do so, will generally find ways to put the knowledge he gains into practical use, to his own pecuniary advantage. There is no reason, because this is an age of machinery, that a man should make a machine of himself.

In our issue of March 3 we published a communication on boiler inspection, reflecting somewhat upon methods sometimes employed by agents of insurance companies. The character of the writer of that article is such as to place any direct statement he made above suspicion. In this issue we publish a letter from a gentleman who is interested in boiler insurance matters. As is his right, he sets forth the other side of the question, to which we invite the attention of our readers.

Personal.

Mr. Henry B. Morris, a former correspondent of the American Machinist, and formerly of Ithaca, N. Y., has recently accepted a position as superintendent of the works of the Rawson Manufacturing Company, of Hornellsville, N. Y.

Literary Notes.

Our progressive contemporary, the *Electrical Review*, does itself proud by coming out with a very decided change in its appearance. It has donned a cream-colored overcoat with front page devoid of advertisement, but replete with title and the representation of electrical phenomena. It looks sprightly and neat in every respect. Turning to the inside pages, the initial number with the new dress is printed with new type from beginning to end, and contains more than the usual number of good things. With characteristic modesty, our contemporary refers to the fact that is so apparent to all its readers, viz., that it appreciates and practices progress. We extend congratulations.

MECHANICAL DRAWING. Prepared for the use of the students of the Massachusetts Institute of Technology, Boston, Mass. By Linus Faunce.

This is a small book of 136 pages, and treats on elementary geometrical problems, inking, tinting, projections, shadows, isometrical drawing, oblique projections, and also contains a few examples of working drawings. We believe this book will be a great assistance to those who wish to learn mechanical drawing at home, and believe it to be extremely well adapted for teaching this science in public schools. The author states in a letter to us that it has already met with such a cordial reception by people outside of Massachusetts Institute of Technology, that he has decided to put it on the market. We understand that it is now used in the Normal Art School, Boston; Rhode Island Technical Drawing School, Providence; Chicago Manual Training School, and others. These books can be obtained of the author, Massachusetts Institute of Technology, Boston, Mass. Retail price $1.25.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(172) J. B. W., Pittsburgh, Pa., will find articles on tempering steel in the American Machinist of July 23, Aug. 6 and 13, and Oct 8, 1887.

(173) Two correspondents who ask about the expansion of zinc and steel will find the best information we have on the subject in our issue of April 30, 1887.

(174) W. W. F., Stockton, Cal., asks: What numbers of the American Machinist contain directions for setting valves? *A.*—June 7, 1884, and Feb. 27, 1886.

(175) H. E. A., Fayetteville, Ark., asks: How are steel faces put on cast-iron anvils? *A.*—By what is called "burning"—a process which is explained in an article by Thos. D. West in the American Machinist of March 1, 1884.

(176) H. A. B. asks: Will steam pipes set fire to tarred building paper if it should come in contact with the pipes? *A.*—We think that, with ordinary saturated steam, there would be no danger, though there is some difference of opinion about the matter.

(177) C. O. W., ———, asks: What is the best process for tempering a long tap? *A.*—See American Machinist, Feb. 21, 1885, and Oct. 8, 1887. 2. What is meant by the term "mogul" and consolidation, as applied to locomotives? *A.*—See American Machinist, July 4, 1885.

(178) E. R. S., Mount Holly, writes: I have a small engine, 3-inch bore and 4-inch stroke ports 1¼ × ⅜ inch. How much power can I get from this engine with 80 pounds boiler pressure engine to run at 150 revolutions, and how large a boiler will I require? *A.*—Something less than one horse-power; boiler with 15 to 20 feet heating surface.

(179) H. G. H., Bay City, Mich., writes: I wish to know the correct and accepted way of measuring or laying out bevel gears. Is it at the small or large pitch circle that the pitch strength of tooth and size of the gear is found? *A.*—At the large pitch circle. You will find the subject treated in the American Machinist of Nov. 10, 1883, and Aug. 30 and June 21, 1884.

(180) J. T. D., ———, asks: 1. What should be the dimensions of a valve to cut-off at three-quarters stroke, the ports being ¼ inch by 3 inches, bridges 5-16 inch, and exhaust port ⅝ inch by 3 inches? *A.*—Outside lap, ¼ inch; inside lap, 1-32 inch; travel of valve, 1 inch. 2. What will be the power of this engine, the cylinder being 3 x 3 inch, 500 revolutions, engine being within 18 inches from boiler, boiler pressure 60 pounds? *A.*—About 2 horse-power.

(181) E. C., Boston, Mass., asks: What is a good mixture for mending holes in castings? *A.*—Holes in castings, when small, and the surface is to be well painted over, are filled with putty. Larger holes are fitted with lead, zinc, babbitt metal, etc. A mixture sometimes used, which will expand in cooling, and so fill holes very closely is composed of lead, 9 parts; antimony, 2 parts; bismuth, 1 part. The bismuth makes this rather costly. Where the holes occur on finished surfaces the only satisfactory plan is to plug them.

(182) J M., Manayunk, Penn., asks: What shall I do to stop leaks in the screw joints of a 10-inch steam-pipe? I can keep them tight for several days with caulking, except at the ells, and generally after Sunday they are as bad as ever. The leaks are midway in a long line of pipe running through the yard to the engine, so tearing it down would cause an expensive delay. *A.*—The cause of leak may be the lack of properly providing for expansion. We do not know of any satisfactory way to make such joints tight, except to screw them up hard, and the quicker you do this the more likely you will be to save the fittings.

(183) K. H., Butte, Mont., asks: 1. How is the polish given to brass work, such as hydrant cocks, gas chandeliers, etc.? *A.*—It is done with grinding and polishing wheels, some of solid emery, others of walrus hide or "sea-horse" charged with polishing material, and others made of cloth and called "rag wheels." "Polishing belts" are also used, which carry the polishing material. 2. Which are the cutting faces on a "B. Morse" die—those which are to the right when the

figures stamped on the die are up, or those which are to the right when the figures are down? *A.*—These dies are so made as to cut either side up. The cutting faces are alike either way, the faces which do the cutting being determined by the way the die is used.

(184) C. A. W., Grand Rapids, Mich., asks: 1. Leaving out first cost, is there much advantage in a compound engine as small as 3″ x 5″? *A.*—No. 2. Will a link motion reverse a pair of compound engines with cranks set at an angle? *A.*—Yes, by using two links. 3. Is it a good plan to put the exhaust port on the side opposite steam port in an upright engine? *A.*—We presume you refer to a belt carrying the exhaust steam around the cylinder. This is verv frequently done, and is only objectionable in that it keeps the exhaust steam in contact with the walls of the cylinder a little longer than advisable. With a small engine it will not make much difference.

(185) M. M., Milwaukee, Wis., asks: 1. Is there a possible gain in compounding machinery of any kind? *A.*—Not as we understand your question. 2. When exhaust steam enters the low pressure cylinder of a compound engine through a four or five inch exhaust pipe, is there any gain? *A.*—There may or may not be, according to circumstances. 3. A steam cylinder 20 inches diameter, piston speed 100 feet per minute; will a 40 inch cylinder use less steam? *A.*—It is quite impossible to tell without knowing more of the conditions. 4. When a certain amount of power is developed in a cylinder per minute does it matter what the size of the cylinder is? *A.*—So far as economy is concerned it usually does matter, materially.

(186) O. E. S., Hamilton, O., writes: 1. I cannot keep up steam when I open the throttle wide. The boiler is of a locomotive type with 25 flues, 2 inches in diameter, 4½ feet long; fire-box, 30 inches long, 22 inches wide, and grate 20 inches from crown sheet. What will be the horse-power of this boiler? *A.*—About 5 to 6 horse-power. 2. The cylinder is 6½ inches in diameter, 12½ inches stroke, making 220 revolutions. What will be the horse-power of this engine? *A.*—You do not state the steam pressure; but assuming the mean effective pressure to be 20 pounds, then the engine will be about 9 horse-power. The reason for not being able to keep up steam is that your boiler is too small. We believe by putting in another boiler of the same size as used now, you will be able to keep up steam and do good work.

(187) H. L. C., St. Louis, Mo., asks: 1. If I admit water into a boiler by means of a spray pipe in the steam space, the temperature of the feed-water being 150° to 180°, would there be much condensation of steam? *A.*—Yes. 2. Would not the quick evaporation of the water, supposing the spray well spread out balance the loss from condensation? *A.*—No, not if the steam is to be used in a steam engine. 3. Would this method of feeding have a tendency to make wet steam under a pressure of 80 or 100 pounds? *A.*—Yes. 4. Would not this method of feeding be taking advantage of the latent heat of steam for the quick heating of the water? *A.*—Any advantage taken in this way would be the reverse of economical. 5 I have heard it argued by good engineers that the theory of latent heat was a myth. I have been taught that water contained no latent heat, but that steam contained a good deal. I should like to be set right upon this. *A.*—Water contains, probably, a small amount of latent heat of expansion: steam contains, as you state it, a good deal of heat, which is called latent heat, or heat of vaporization. You will find the latent heat of steam explained in nearly or quite every work on steam engineering.

(188) H. E. W., Manchester, N. H., writes: Please inform me of about how much power I may expect to get from an upright engine, cylinder 1⅛ inch diameter, 1¾ stroke, boiler 11 inches diameter, 24 inches high; fire box, 10 inches x 10 inches; boiler will stand 300 pounds pressure; expect to run it at about 60 pounds. Boiler has 36 tubes, ¾ x 8 inches. Also will the above rig be large enough for a boat 16 feet x 3 feet, and 14 inches deep? Also how large propeller should I use? *A.*—Running the engine at a speed of 300 revolutions with 40 pounds mean effective pressure, you will obtain about 0.16 of a horse-power. As for the boiler, we believe the tubes are too small in diameter. Our experience has been that very little heat passes through flues so small in diameter, and that the heating surface in the furnace is about all the steam generating surface in the boiler of this kind. We also infer from the diameter of the flues that these are made of copper. Small copper flues are soon coated with soot, which soon makes these flues non-conductors of heat. The total heating surface in your boiler is about or nearly sufficient for one-half of a horse-power, but on account of the small diameter of the flues, we believe you will not obtain more than one-quarter of a horse-power. The engine and boiler are not large enough for the boat, as the speed of the boat with this rig would be too slow. You will require a propeller about 10 inches in diameter.

(189) A. K., Philadelphia, Pa., writes: We have a return tubular boiler rated at 80 horse-power, 16 feet long, 60 inches diameter, made in five rings; all horizontal seams are double-riveted (staggered). The curvilinear seam cracked from the rivets to the edge. We repaired several times with little success; finally we concluded to cut the lower half out of the two sheets, and put in one sheet about 72 inches long and about 90 inches girthwise; our pressure limit is 80 pounds, and we do not want to reduce it. The boiler maker calls it a patch, and says a horizontal seam is just as strong single-riveted with ¾ rivets, 2 inches centers, as a seam double-riveted (staggered) with ⅝ rivets, 2⅛ inches centers. Will you kindly give us your opinion? *A.*—A riveted joint subjected to tension such as occurs in boilers, can break, first, by tearing the plate; in this case its strength is measured by the tensile strength of the plate multiplied by its least sectional area; this least sectional area lies on a straight line passing through the center of rivets, and depends upon the thickness of the plate and the diameter and spacing of the rivets. Second, the joint can break by shearing of the rivets; in this case the strength of the joint is measured by the shearing strength multiplied by the sectional area of the rivets. Third, the joint can break in consequence of the thrust exerted by the rivets on the plate, which may cause it either to be crushed, or to split, or have a portion sheared out from the rivet holes to the edge of the plate; in this case the strength of the joint depends on the diameter of the rivets, the thickness of the plate, the width of the lap, and a co-efficient of resistance depending on the nature of the fracture. The shearing of the plate from the rivet holes to the edge is, however, not likely to take place with the ordinary proportions of lap and rivets, and therefore we will leave this cause of fracture out of consideration. The thickness of the shell has not been given, but we will assume it to be ⅝ of an inch. For the sake of easy comparison we will take a strip of boiler plate 10 inches wide. In laying off across this strip a double-riveted seam with ⅝ rivets, 2⅛ inches centers, we find that this seam will just contain 8 rivets. Again, in laying off the single-riveted seam having ¾ rivets, 2 inches centers, we find that this seam across our strip will just contain 5 rivets. Comparing in each seam the least sectional area of the plate with the total cross-sectional area of all the rivets in the seam, we find that in both cases the cross-sectional area of the rivets is less than the least sectional area of the plate. We may therefore say, that the strength of the joints in this strip depends on the strength of the rivets. The area of a ⅝ rivet is .3067, and this area multiplied by the number of rivets in the seam of our 10 inch strip gives $.3067 \times 8 = 2.4536$ square inches, which is the total cross-sectional area of all the rivets in the double-riveted seam. The area of a ¾ rivet is .4417; multiplying this area by the number of rivets in the single seam, we have $.4417 \times 5 = 2.2085$ square inches, which is the total cross-sectional area in all rivets in the single-riveted seam. Now, since in the double-riveted seam we must overcome the strength of 2.4536 square inches, and in the single seam only 2.2085 square inches, it follows that the double-rivet seam is the strongest. There is another cause which may render the single-riveted joint considerably weaker than the double-riveted joint, and that is the distance between the centers of the rivets in the single-riveted joint is 2 inches, which leaves the least sectional area of the plate but very little larger than the cross-sectional area of the rivets; and if the holes for the ¾ rivets are punched instead of drilled, the metal in the plate will be injured, and thereby the strength of the boiler reduced. We prefer the double riveted joint, holes for rivets drilled and the seam kept out of thefire.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Planed bevel gears. Grant, see page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Before you buy a lathe write Lodge, Davis & Co.

Before you buy a shaper write Lodge, Davis & Co.

Before you buy a drill press write Lodge, Davis & Co.

Before you buy a brass lathe write Lodge, Davis & Co.

Before you buy any machine tools write Lodge, Davis & Co.

Special drives in 2d-hand tools Lodge, Davis & Co.

See special ads. pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co, 56 Beekman street, New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Light and fine machinery to order; foot lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

For first-class automatic engines write to Williams Engine Co., 447 North street, Baltimore, Md.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Upright drills; we make the best; write for price before you buy. Currier & Snyder, Worcester, Mass.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Nicholson & Waterman, Providence, R. I., two 48 in. horizontal boring mills; 5 in. cutting off machines; 14, 16, and 30 in. engine lathes.

Robertson's damper regulator; no diaphragms, springs or packing: the cheapest good regulator in market. Hine & Robertson, 45 Cortlandt st., N. Y.

Iron, brass and copper spooled wire is a necessity to the consumer and a great convenience to the trade. S. A. Smith, agent, 23 Canal st., Chicago, Ill.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See March 10, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Patent Attorney. R. G. DuBois, 916 F. st., Washington, D. C. Reliable service at reasonable rates. Send for 38-page pamphlet containing list of references.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

New book on gears; ask dealers in books and machinists' fine tools to send for one, or send for one yourself by P. O. note. Price, 50 cents. Address Chas. B. Long, M. E., Worcester, Mass.

Randall's copper-tipped hammers are something that every machinist should have; ask your dealer to show you one, and if he does not keep them, write to Montgomery & Co., 105 Fulton st., N. Y.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Special facilities for manufacturing of all kinds of light hardware and novelties by contract or otherwise; presswork and stamping done on short notice. Acme B. H. Att Co., Limited, 74 5th ave., N. Y.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, will please write to the manufacturers, E. E. Garvin & Co, 139, 141, 143 Centre st., New York City.

The Dieble Mfg. Co., Philadelphia, Pa., mfrs. of the Challenge emery grinding and polishing machinery, invite correspondence with all needing this class of machinery. Catalogues and prices on application.

Hot Water Supply. A practical treatise on the fitting of hot water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 13mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the American Machinist. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Pub'g Co., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the American Machinist, should be closely followed by every student. They commenced with October 29, 1886 issue, and up to and including April 7, 1888 issue 47 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. American Machinist Publishing Co., 96 Fulton street. New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the American Machinist, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 61 articles have thus far appeared up to and including the March 31, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

Manufactures

J. T. Moore will build a saw mill at Creswell, Ga.

W. N. Maddax will build a saw mill at Perth, Miss.

The Georgia Lumber Company will build a mill at Atlanta, Ga.

Bowie, George & Terhune will build a machine shop at Rome, Ga.

The Columbus, Ga., Water-Works Company will enlarge its works.

Teeple & Brooks will build a large saw mill at Tuscaloosa, Ala.

The Atlanta (Ga.) School of Technology will build a machine shop.

The Mayor of Paris, Ky., will receive propositions for water works.

E. E. Tibbetts will build a spoke factory at Charleston, W. Va.

William Donavin & Co. will rebuild their saw-mill at Norfolk, Va.

The Annapolis (Md.) Electric Light Company has been organized.

An excelsior factory will be built at Atlanta, Ga., by Charles Cohen.

Claywell Bros. expect to build a furniture factory at Morganton, N. C.

J. L. Girton is interested in building a flour mill at Winchester, Tenn.

J. & D. Noble, Anniston, Ala., contemplate increasing the capacity of their boiler works.

The Pennsylvania Railroad Company is discharging men from its shops at Fort Wayne, Ind.

The Stonewall Manufacturing Company expect to build a cotton factory at Enterprise, Miss.

Smith & Settle are building an addition to their machine shop and foundry at Russellville, Ark.

The Manchester (Tenn.) Manufacturing Company has been organized to make spokes and handles.

George G. Deposier is interested in building a sash, door and blind factory at Jacksonville, Ala.

The Mann Boudoir Car Company has leased five acres of land at Ludlow, Ky., upon which to erect machine shops.

The Avondale (Ala.) Iron Works have let contracts for additional buildings to increase the capacity of their works.

The Keystone Iron Works have purchased a tract of land at Riverview, Kansas, and propose to erect a plant to employ 600 men.

E. & F. N. Spon, publishers and importers of scientific books, will remove from 35 Murray street to 12 Cortlandt street, New York, on or about April 2.

L. Starrett, Athol, Mass., has issued a new catalogue and price-list of machinists' small tools. It contains illustrations and descriptions of several new tools, also a revised price-list.

New water-works or reconstruction of old works are contemplated at Huntington, Pa.; Hugoton, Kan.; New London, Wis.; Avon, N. Y.; Morrisonville, Ill.; Beatrice, Neb.; Allegheny, Pa.; Urichville, Ohio; Ballston, N. Y.

The Craig Sight Feed Lubricator Company, Lawrence, Mass., have a largely increasing business in their lubricators. They have increased their business fully threefold within a short time, and find further increase necessary.

William Coutie & Son, Troy, N. Y., are busy in their shops, largely on compound engines. Amongst other work in hand is a 400 horse-power engine for the Glens Falls Paper Mill Company; also a 60 horse-power engine for the same company. They are now erecting a 250 horse-power compound engine for the Pompton, N. J., powder mills.

The Cleveland Twist Drill Company, Cleveland, Ohio, recently sent the following notice to their patrons: "The unexpected has happened. Our boiler has given out just as we need it the most. This delay in our busiest season is quite serious, and we beg the indulgence of our patrons for a few days, when we shall be able to fill all orders promptly, we hope."

Owing to the rapidly increasing demand for the Reliance safety water columns, the Reliance Gauge Company, of Cleveland, O., who had already greatly increased their facilities, have found it necessary to enlarge their works. They have leased a four-story building at 836 Sheriff street, for a term of years, and put in steam power as well as considerable new machinery.

Among recent orders for Porter-Hamilton engines at the works of William Tod & Co., Youngstown, O., are six from the Carnegie steel mills, aggregating 820 horse-power; two from the Hartford Pulp Company of 300 horse-power; two from the Marion Pulp Company, of 900 horse-power; a 450 horse-power from the Straight Fiber Iron Company, Chicago, and a 75 horse-power from Parker & Johnston, Logansport, Ind. They are also building a new pattern hydraulic accumulator for the Crescent Steel Works, and making the rod nets for the new rod mill of the Joliet Steel Company.

H. F. Hubbard, Sterling, Ill., writes us: The citizens of Sterling intend to build a new dam one mile above the old one, across Rock River. This dam will give between 6 and 7 feet fall, and will have a reservoir of about 8 miles. This will give almost unlimited power, equal to any in the country, the river at this point being over 1,000 feet wide, with stone banks and bed. It is the intention of the citizens to give this water-power free, to good, substantial manufacturers; also grounds to build factories. The different railroads will lay side tracks to accommodate manufacturers.

The Silvey Electric Company, of Lima, Ohio, are making, besides dynamos, stationary motors of various sizes, arc lamps, and fittings for complete electric light installations. One form of the arc lamp is made for an incandescent circuit, and is guaranteed to work successfully on any incandescent circuit. It is of two thousand nominal candle-power, and takes the same amount of power as ten incandescent lights, and is claimed to be the most economical way of obtaining a large amount of light. They have also perfected an arc lamp for headlight or focusing purposes, which is especially adapted for use in locomotive headlights.

Some months since, at the request of the Geo. F. Blake Manufacturing Company, the Mason Regulator Company, Boston, Mass., designed and built six pump pressure regulators for use on the pumps of the Boston Heating Company, which maintain a pressure of nearly 400 pounds of superheated water in the service pipes. The regulators, both under test at the factory and under service, were found to keep this pressure with scarcely any perceptible variation; stopping and starting the pumps, without jar or jumping. The Mason Company have also designed a safety attachment, which immediately stops a pump when the pressure suddenly falls below any required point, as is sometimes the case on water-works and pressure pumps, when mains break or hydrants are suddenly opened.

Machinists' Supplies and Iron.

New York, March 22, 1888.

Iron — American Pig — We quote Standard Lehigh brands $21 to $21.50 for No. 1 X Foundry, with outside brands at $20 to $20.50, No. 2 Foundry $19 to $19.50 for Standard Lehigh brands.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page eleven.

Pattern maker of experience wants situation; accustomed to general machine work. S. R., Am. Mach.

Wanted—A die maker to make cutting dies for steel and keep presses in order. Cary & Moen, 234 West 29th st., N. Y. City.

A first-class draftsman with good experience able to take charge of the drawing office, wants a position. S. H., Am Machinist.

Wanted—A draftsman experienced on locomotive and car work. Address, giving age, experience, references, etc., B., care Am. Machinist.

Wanted—Situation by first-class pattern maker who desires change of location. Henry Dick, care Adams & Richards Mach. Co., New Brunswick, N. J.

Practical boiler maker wants position as foreman, or take charge of boiler work in roundhouse, or large steam plant. Address Os., 222 S. 17th street, Harrisburg, Pa.

Wanted—Situation by foreman brass moulder who thoroughly understands trade and mixing of all kinds of brass and refining of scrap brass. Address Brass Moulder, Am. Machinist.

Wanted—By experienced foundry foreman, situation; acquainted with general heavy work; good knowledge of cupolas; experience in brass; testimonials. Address Foundry Foreman, Am. Machinist.

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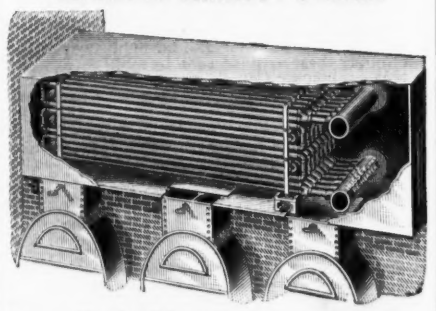

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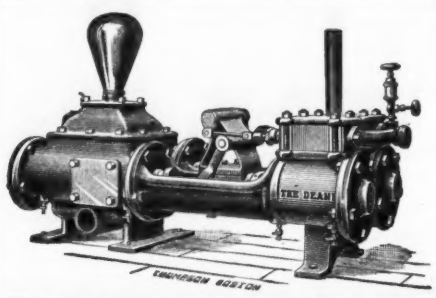

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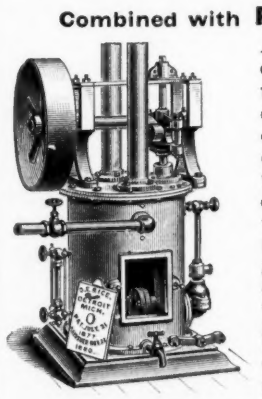

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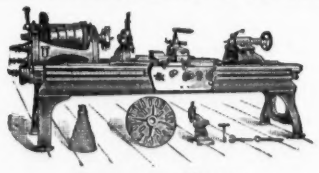

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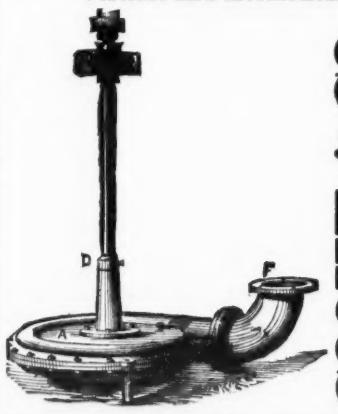

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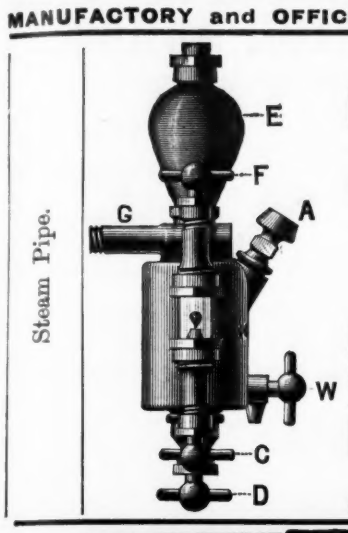

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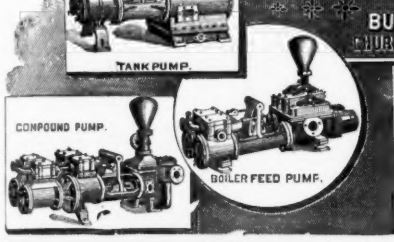

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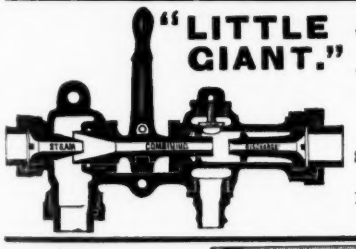

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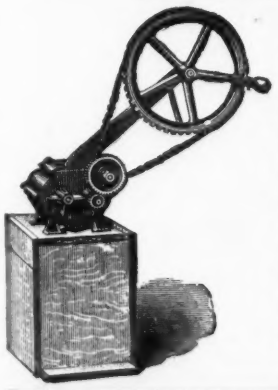

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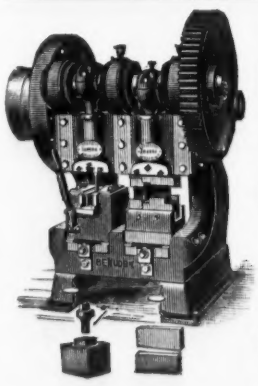

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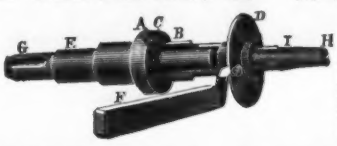

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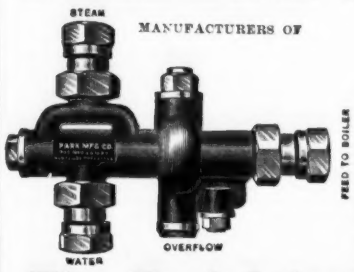

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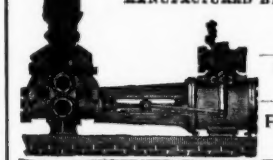

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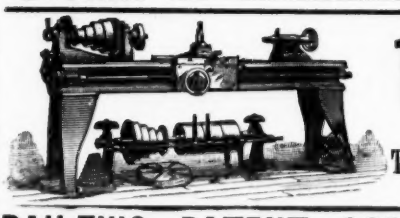

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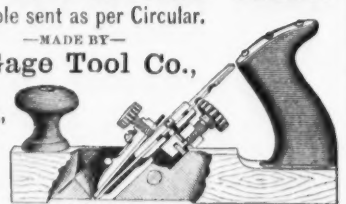

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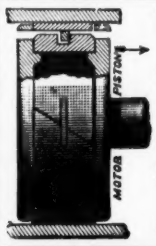

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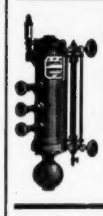

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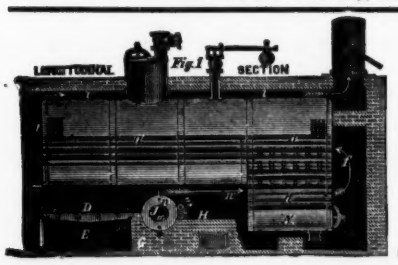

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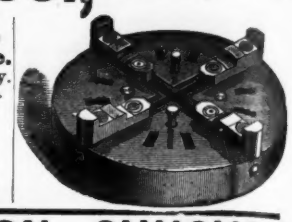

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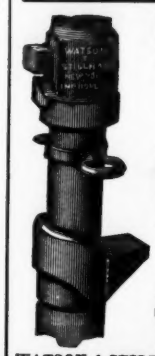

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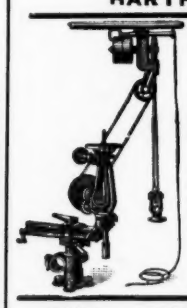

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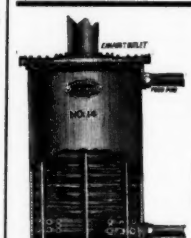

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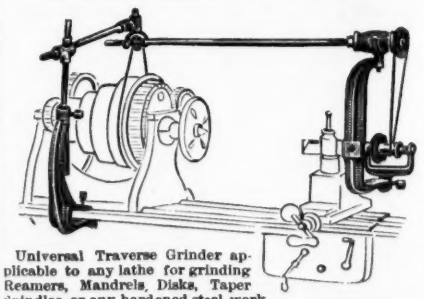

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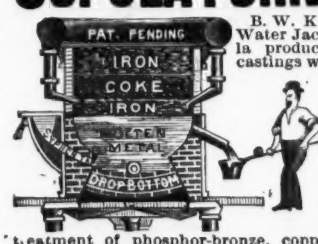

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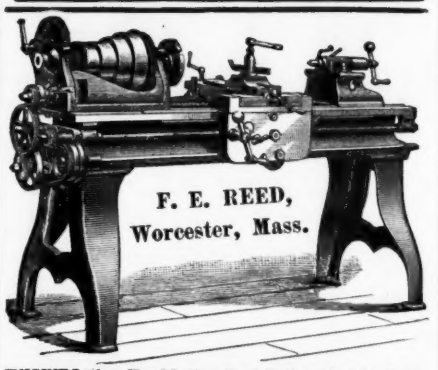

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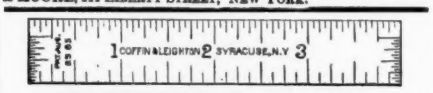

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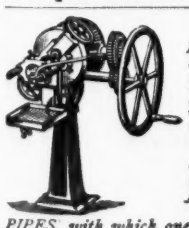

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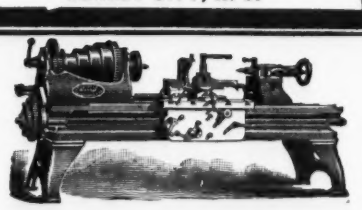

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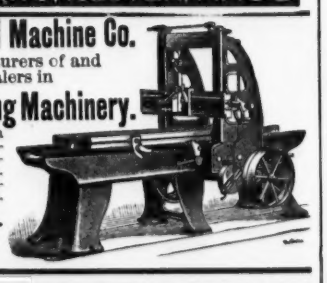

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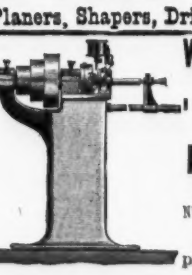

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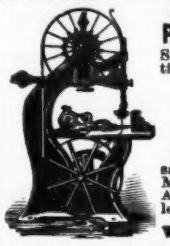

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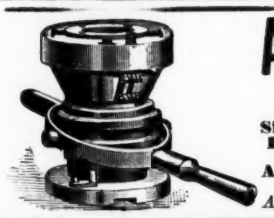

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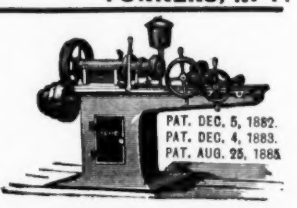

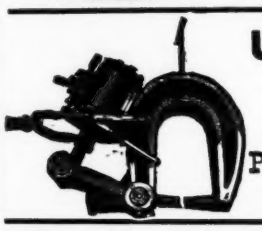

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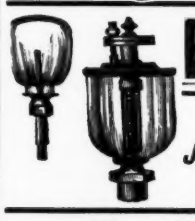

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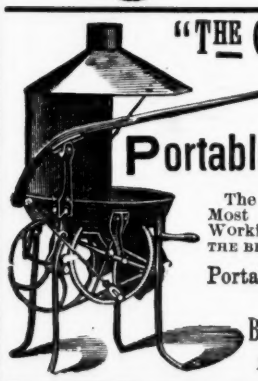

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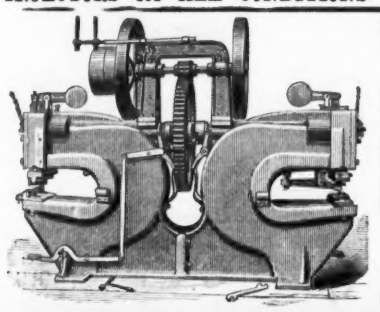

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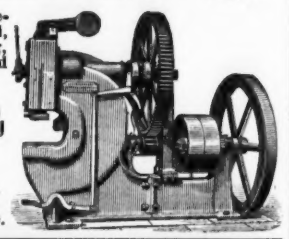

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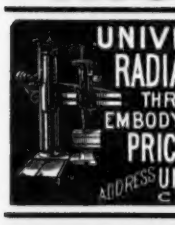

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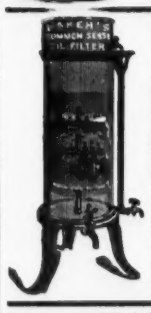

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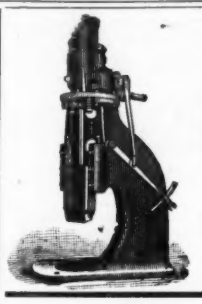

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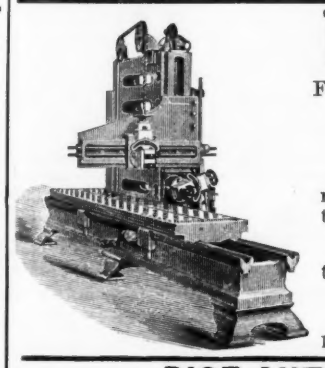

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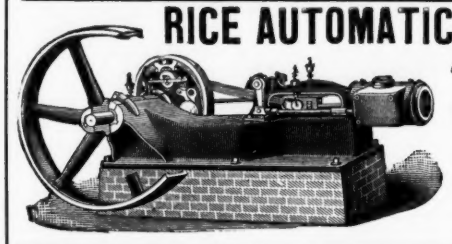

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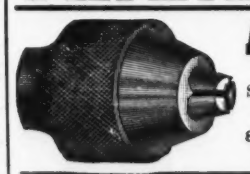

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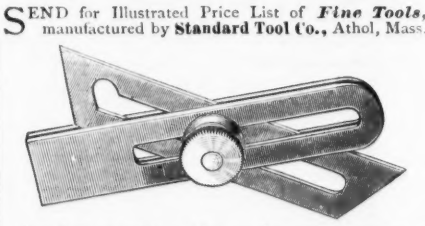

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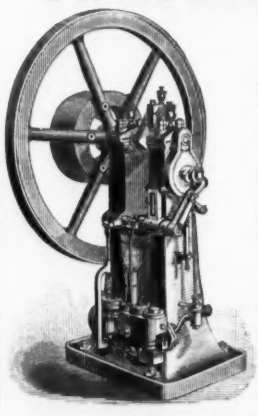

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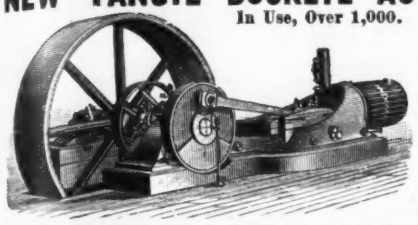

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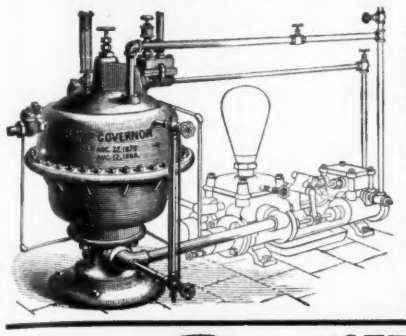

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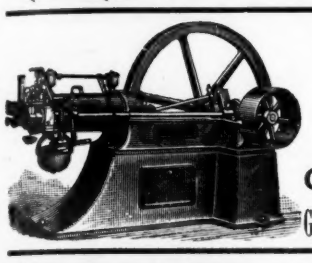

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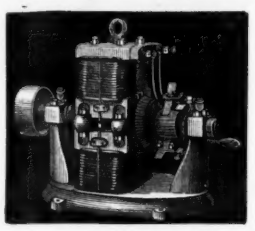

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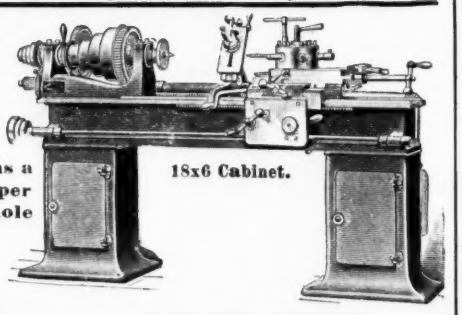

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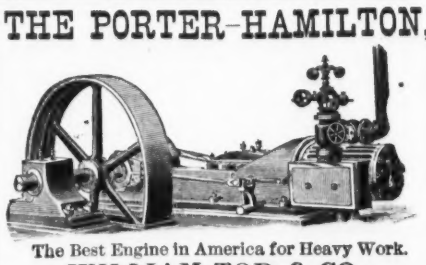

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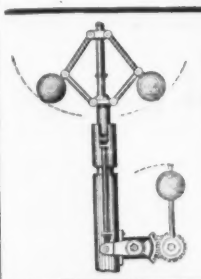

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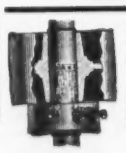

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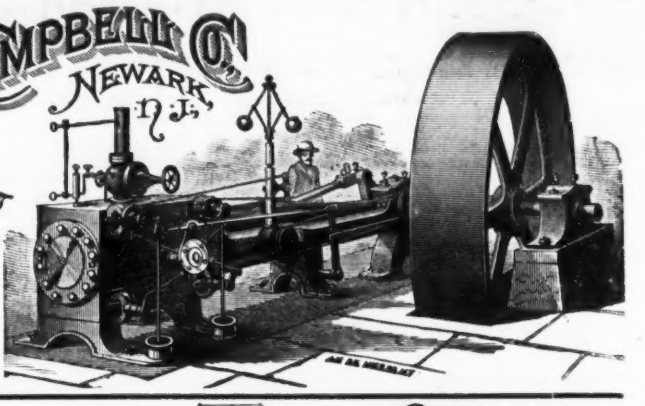

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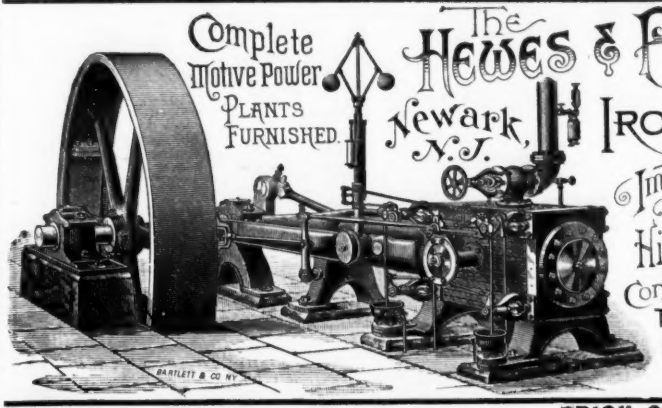

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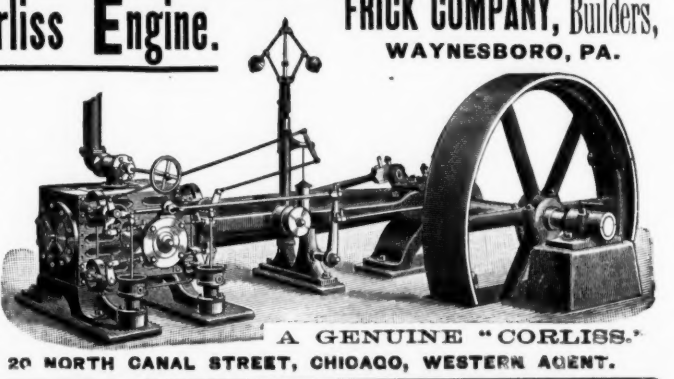

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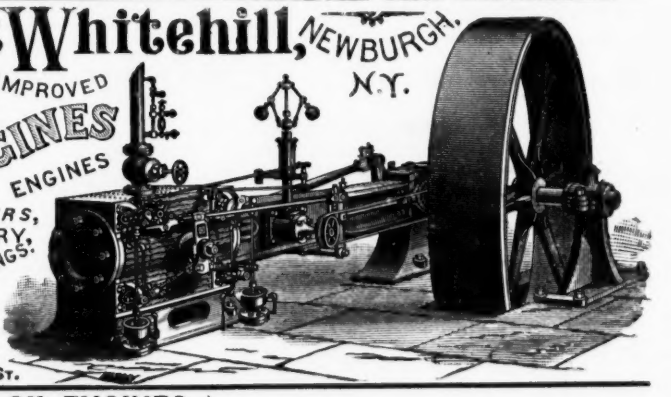

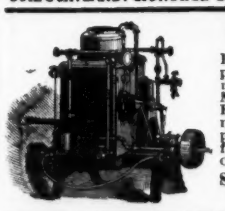

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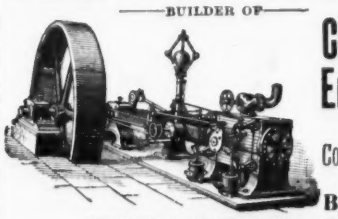

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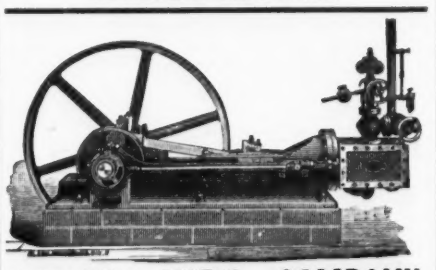

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33 "	" 12 "	" "	Portland Co.
18 "	" 7 "	" "	David W. Pond.
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Putnam " " 60 " " 9 " "
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Wiley and Russell Bolt Cutter No. 5, cuts ¾ to 1¼"
Brown & Sharpe Screw Machine No. 5, largest size.
Brainard No. 7 Milling Machine with Vise.
Car Wheel Borer, 48 in swing. Fine Condition.
Pond Index Milling Machine.
Brainard Gear Cutter, 30 in. Automatic Feed.
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Garvin No. 2 Gauge Drill, 2 spindles.
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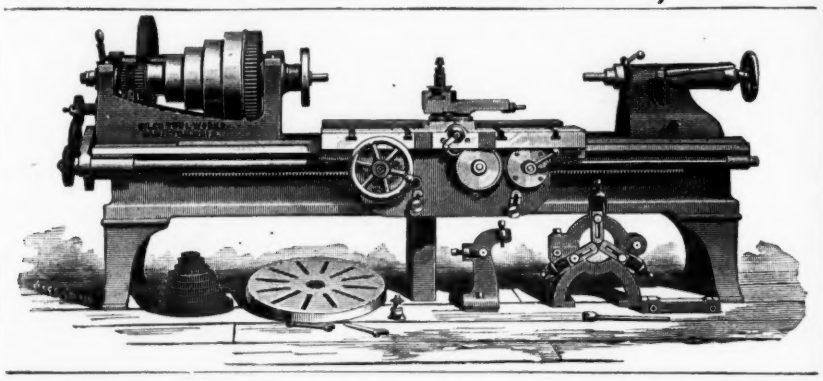

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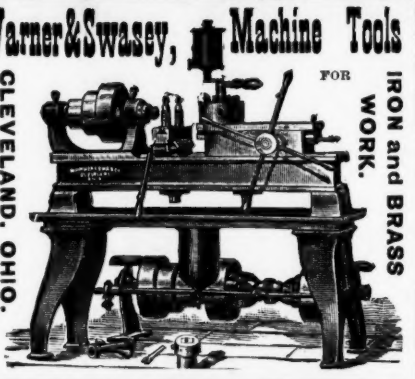

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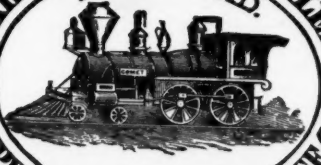

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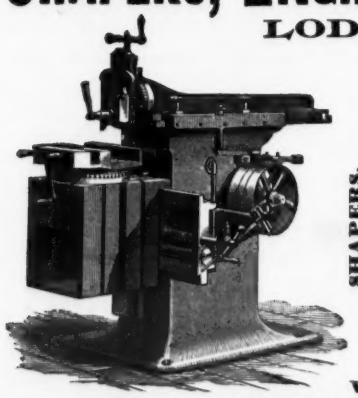

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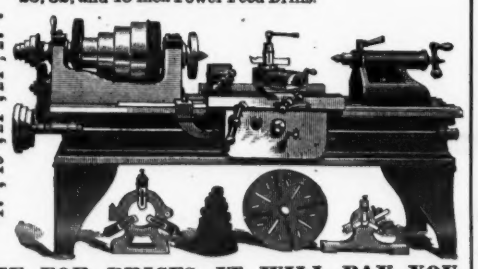

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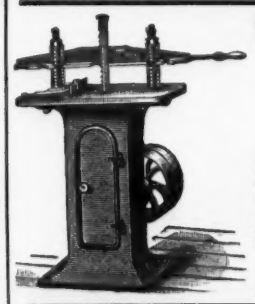

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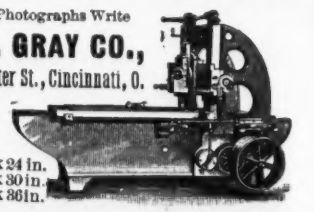

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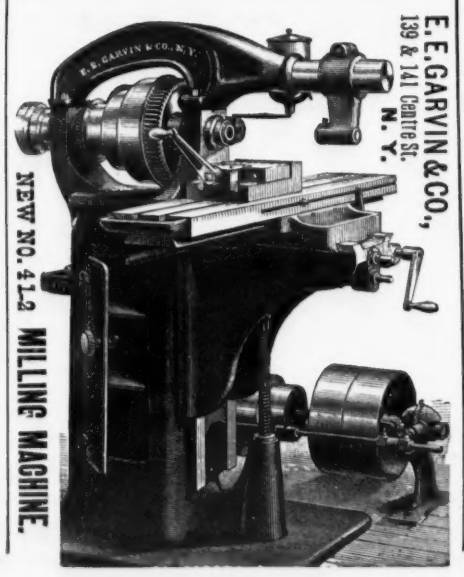

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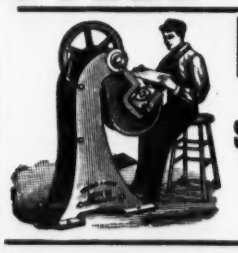

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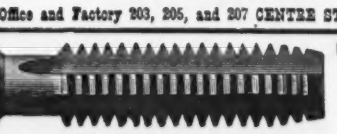

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